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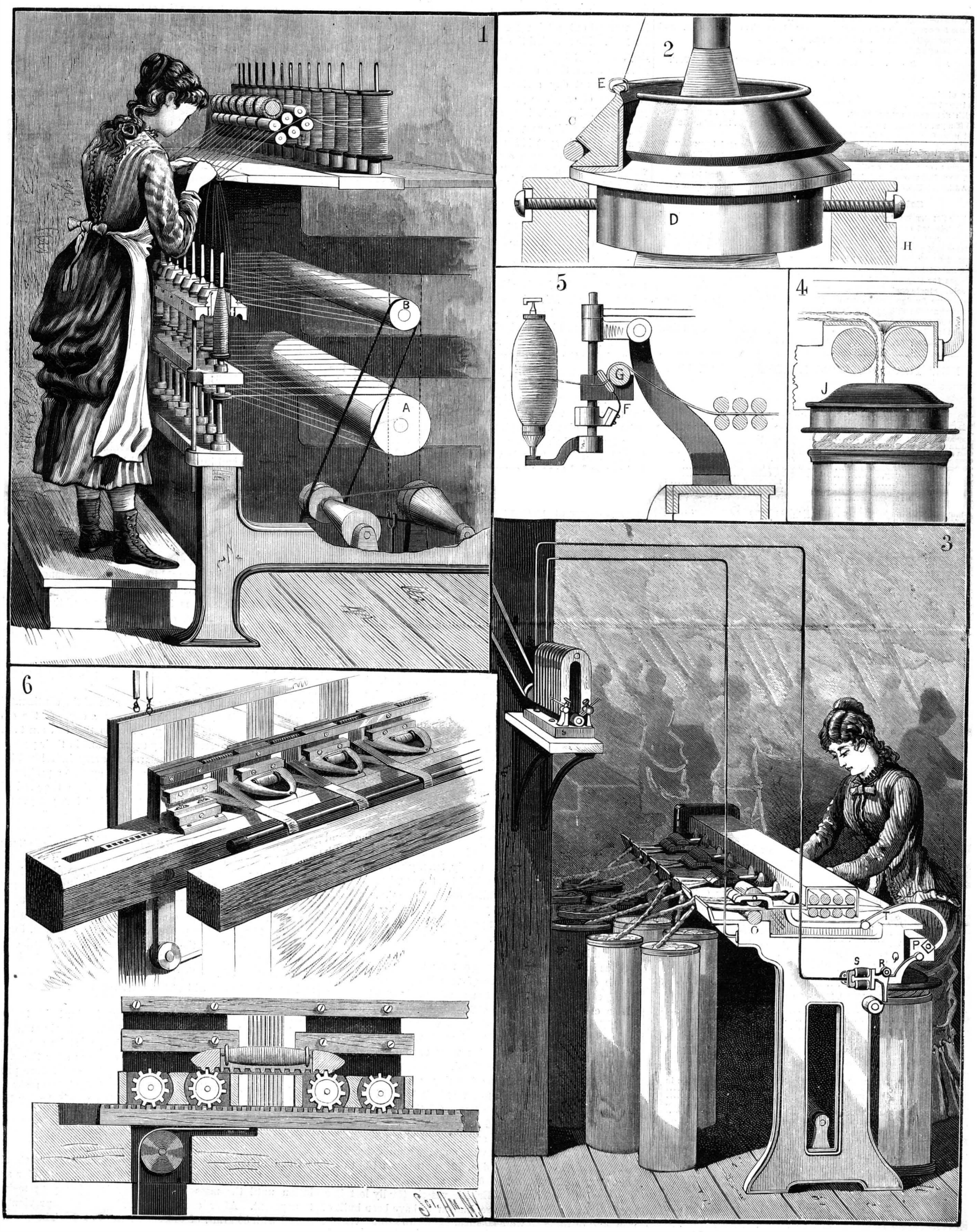

NOVELTIES AT THE NEW ENGLAND INSTITUTE FAIR, BOSTON—[See page 340.]

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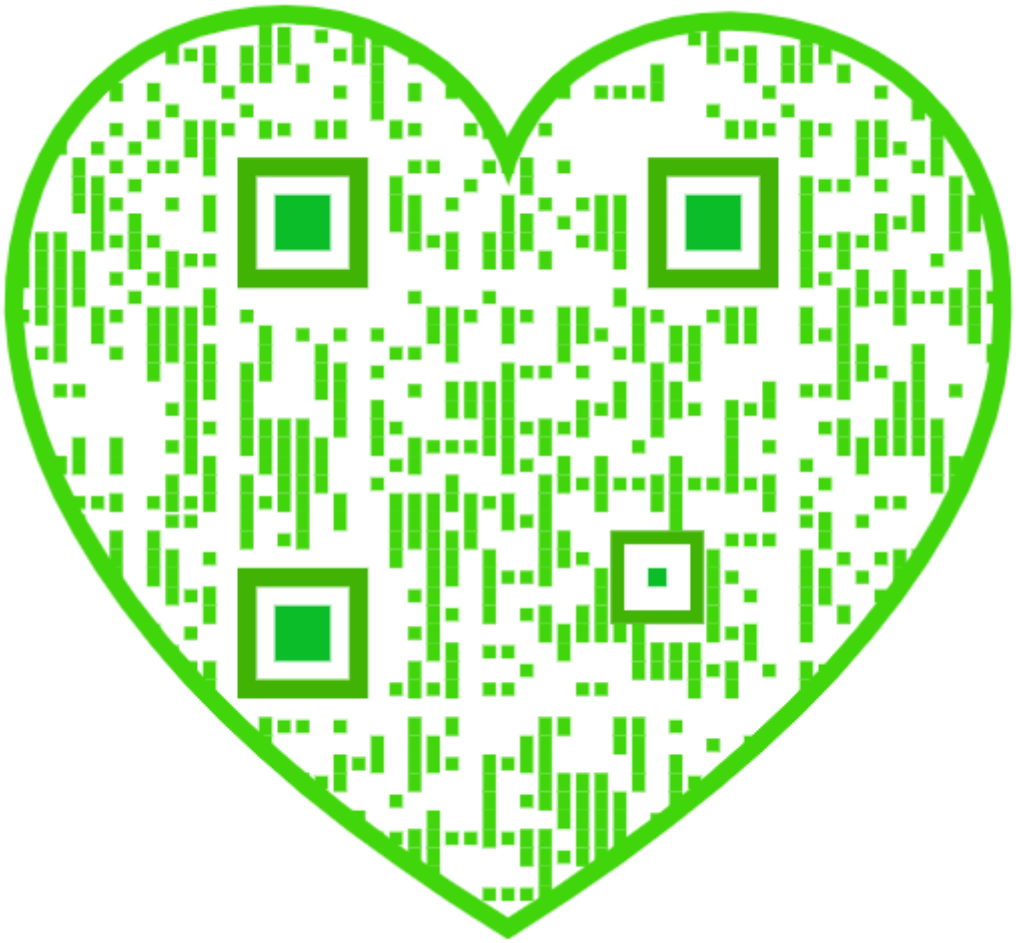

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TRANSITS OF VENUS.

Astronomical annals record the observation of only four transits of Venus: those of 1639, 1761, 1769, and 1874. Kepler was the first astronomer to predict that a transit would occur in 1631. But it passed unobserved, and his tables were so inaccurate that he failed to detect the transit that would take place in 1639. This too would have passed unobserved had it not been for the enterprise and enthusiasm of a young Englishman, the curate of a church in the north of England. Jeremiah Horrox, though only eighteen years of age, had mastered all known astronomical problems. He discovered that Kepler's tables indicated a near approach of a transit of Venus. The hope that he might witness the wonderful sight took possession of his imagination, and day and night he studied the tables of Kepler until he discovered an inaccuracy in the calculations. He worked out a table for himself, and predicted a transit for 1639. He revealed the secret to an intimate friend, and they, keeping their own counsel, patiently waited for the advent of the time that would verify the prediction. At last the great day arrived. It was Sunday, and bright, cool, and clear. The young astronomer sat in a darkened room, with the sun's image reflected through a small telescope upon a white screen, over which the planet must pass as a round dark spot if his calculations were correct.

Such was his extreme conscientiousness, that he left his watch when the church bell rang, to fulfill what he considered a higher duty. But his patient labor was rewarded. On his return from service, he discovered on the luminous image of the sun, the tiny black sphere that marked the passage of Venus across his disk, and thus won the honor of being the observer of the first transit ever seen by mortal eye.

A new interest was roused in astronomy by the report of the great event. During the interval between this and the next transit of 1761, science made rapid progress. Transits of Venus were, however, considered only as astronomical curiosities, until in 1677, Halley, while observing a transit of Mercury, discovered their scientific import as a means of determining the sun's distance.

Extensive preparations were made in prospect of the transits of 1761 and 1769. That of 1761 was visible in Europe, and was watched by nearly two hundred observers, but the results were unimportant. That of 1769 was more extensively observed, but the instruments of those days were far from being accurate. When the astronomers returned from distant lands with the results of their labor, and proceeded to make comparisons in order to deduce the sun's parallax, great discordance was found in the measurements of the different observers. More than half a century elapsed before the results were worked up in a satisfactory manner. This was done by Encke in 1824, and 8·57″ was fixed as the solar parallax, corresponding to about 95,000,000 miles. This distance of the sun was for many years accepted by astronomers, and adopted by all works on astronomy.

It is now well known that the parallax was too small, and the distance too great, including an error of nearly 3,000,000 miles. The world-wide interest taken in the transit of 1874 and its extensive observance is a matter too near the occurrence of the present transit to have become a matter of history. The work of reducing the observations has not yet reached a final result, for an immense amount of calculations and much tedious investigation are involved. The indications are, from portions of the work accomplished, that the sun's parallax lies somewhere between 8·79″ and 8·83″. The sole purpose for which the transit expeditions of 1882 are sent to the most available localities for witnessing the phenomenon is to determine more accurately this most important base line of celestial measurement. The whole scientific world will watch for the result, while approximation, not certainty, is all that is anticipated.

SHIPWRECKS ON THE BRITISH COASTS.

During the past twenty-five years about fifty-five thousand wrecks, casualties, and collisions have occurred on the British coasts, involving the loss of nearly twenty thousand lives. But once since the season of 1874–5 has the number of marine disasters in a twelvemonth fallen below three thousand, the most disastrous year being that of 1876–7, when the casualties numbered 4,164. Last year the number was 3,575, involving the loss of 984 lives. Only 705 cases involved total loss, and lives were lost in 238.

Since in cases of collision two or more vessels are involved in one casualty, the number of vessels more or less hurt (4,297) considerably exceeds the number of casualties.

The collisions numbered 713, and the other wrecks and casualties 2,862. Of the latter 636 were wrecks, etc., resulting in total loss, and serious damage was experienced in 670 cases. The heaviest losses were encountered on the east coast of England and Scotland.

Out of the 2,862 casualties other than collisions 2,569 occurred to vessels belonging to Great Britain and its dependencies, and 293 to foreign ships. Of these 2,569 British vessels, 1,732 were employed in the coasting trade, 667 in the foreign and home trade, and 170 as fishing vessels.

Of the 2,569 British ships which met with disaster, 1,341 did not exceed 100 tons burden, 791 were from 100 to 300 tons, 170 were from 300 to 500 tons, and 267 were above 500 tons burden. Of the 540 British vessels totally lost irrespective of collisions, 44 are known to have been built of iron, and of these 30 were steamships and 10 sailing vessels.

A most remarkable showing appears in connection with the ages of the vessels that were wrecked or otherwise injured, some three-fifths of these having been over fifteen years old. Excluding collisions, 495 steamships and 2,367 sailing vessels were lost, or damaged, on the British Coasts during the year. Of these disasters 146 happened to nearly new ships, 322 to ships from three to seven years of age, 506 to ships from seven to fourteen years old, 932 to ships from fifteen to thirty years old, 463 to ships from thirty to fifty years old, 59 to ships from fifty to sixty years old, 34 from sixty to seventy years old, 6 from seventy to eighty, 7 from eighty to ninety, 5 from ninety to one hundred, and 6 to vessels upward of one hundred years old; while the ages of 83 are unknown. It would be interesting to know more of the history of those ancient vessels, the circumstances under which they met with disaster, and for how much they were insured.

In the course of the year the entrances and clearances of vessels at all the ports of the United kingdom numbered 668,000, and the number of persons carried on all occasions was probably between three and four millions. The loss of a thousand lives may seem by comparison a small number; but its actual magnitude is not to be so rated. And when we consider how many thousands of vessels, and hundreds of thousands of passengers and seamen (not around the British islands only, but on all the seas and along all the coasts of the whole world), are constantly exposed to the hazards of storm and sea, we begin to see how large is the need of improved devices for saving life and property when subjected to such hazards. The lifeboats of the National Lifeboat Institution are credited with saving something like twelve thousand lives during the past quarter century—evidence enough of the value of one line of invention and effort in that small part of the world. Equally valuable inventions doubtless remain to be made.

THE RABBIT PLAGUE IN AUSTRALIA.—A BIG CHANCE FOR A PAYING INVENTION.

The ancient saying that the race is not always to the swift nor the battle to the strong is receiving a new illustration in Australia. Of all animals the timid rabbit would seem to be the last that would ever wage a war of extermination against man; and yet that is precisely what it is doing in Australia. One colony has already lost two millions of sheep by them; the plague is spreading northward at the rate of 100 miles or more a year; and the *Federal Australian* says that the rabbit invasion threatens the great industry of the colony with ruin. "The impossibility of feeding large flocks of sheep and innumerable rabbits at the same time on the same breadth of pasturage, is just as great as would be that of growing wheat and hay on the same soil. There is only one alternative in this case: either the flock owners must expel the rabbits, or the rabbits will expel the flock owners." The conviction is that the evil has attained a magnitude which puts it beyond the hope of control by local efforts, or even by any one colony. The movement for the extermination of the rabbits must be simultaneous and universal to be of any avail.

The proposition now is for a general act of the colonial assemblies levying a tax on all lands, whether stocked or not, to meet the cost of a general war upon the invaders by the colonial governments. It is proposed that each colony shall appoint a staff of rabbit inspectors to enforce repressive legislation, each colony undertaking to keep its own borders free from the plague.

"The flock owners over the entire area of the continent," says the *Australian*, "must make common cause in the endeavor to exterminate the plague, and to that end must aid their respective governments by every means in their power. War to the knife must be declared by every individual interested in station property in Australia against a pestilence which positively threatens nothing less than the gradual destruction of the wealthiest interest that has yet grown into flourishing existence in this part of the world."

Having declared general war upon the rabbits, the great question would appear to be the devising of modes of attack that will be at once efficient and economical. One flock-owner is mentioned as having trapped 5,000 of the little pests in a space of four months; others have tried general poisoning, and yet no perceptible check has been put upon the rapid multiplication of the prolific and all-devouring vermin. Shooting the rabbits is out of the question, there are so many of them, their wariness and burrowing habits adding to the hopelessness of meeting the invasion by individual destruction. They must be killed by the million, and at a cost that will not exceed the value of the land reclaimed from their ravages.

Probably the most welcome guest in Australia to-day would be the inventor of a solution for this pressing and all important problem. The money values at stake are enormous; and the successful inventor of a cure for the evil, which so gravely threatens the prosperity and future progress of the Australian colonies, would doubtless make as good a thing for himself as his invention would be for the sheep raisers.

Solidified Tea.

One hundred grms. of ground sugar and 10 grms. starch sugar are boiled with the quantity of water required for solution, until the mass becomes tenacious, but yet remains transparent. After cooling, 50 grms. of tea previously mixed with 50 grms. of dry sugar, are added. The plastic mass is pressed into moulds, and when solidified forms the preserved tea.

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ASPECTS OF THE PLANETS FOR DECEMBER.

VENUS

will be evening star until the 6th, and morning star the rest of the month. On the 6th, the great events of her inferior conjunction and transit take place. Such is the importance attached to the phenomena that the planetary interest of the month culminates around the fairest and brightest of the solar brotherhood. Few are the persons of ordinary intelligence who will not do as much toward the celebration of the rare event as, with the simple aid of a piece of smoked glass, to follow the course of the planet across the sun's disk at some time during the passage.

The transit will commence over the whole United States at nearly the same minute of absolute time, although owing to errors in the tables of Venus, the prediction for the time of beginning may vary a minute. The principal phases are as follows, in Washington mean time:

First contact	8 h. 55 m. A.M.
First internal contact	9 h. 16 m. A.M.
Second internal contact	2 h. 38 m. P.M.
Last contact	3 h. P.M.

Observers must ascertain the longitude of their places of observation from Washington, and the local time will easily be found, remembering that every degree of longitude makes a difference of four minutes in time; if the place be east of Washington, the time will be later; if it be west, the time will be earlier. Thus the transit will commence in New York twelve minutes later than at Washington, at 9 h. 7 m. A.M ; in Boston and all New England, twenty four minutes later, at 9 h. 19 m. A.M.; in Cincinnati, twenty-nine minutes earlier, 8 h. 26 m. A.M., and so on.

It is to scientific observers that the transit has the deepest significance as one method of determining the sun's distance with more reliable accuracy. Never in the history of the world were such preparations made for the observation of a scientific event. The governments of the most enlightened nations have furnished the means, the best astronomers direct the expeditions, and the whole world watches the result. Stations dot the western hemisphere and a portion of the eastern, where Russian, German, French, Italian, British, and American observers vie with each other in attempts to solve the vexed problem. The money appropriated will reach millions, the scientific observers will be numbered by thousands, and the labor and painstaking employed cannot be computed in numbers. Unless the whole sky is curtained with clouds on the eventful day, there will be good fortune for some of the transit observers.

But the transit is not without its drawback. In consequence of the inferior conjunction of which the transit is an effect we lose the most beautiful of the planets from the evening sky. For Venus will then pass to the sun's western side, and play the role of morning star for 292 days to come. In a week after the transit, she may be seen in the east, close to the sun, and, at the end of the month, she will be a superb object in the morning sky, rising two hours and a half before the sun, and sharing with the comet, if the erratic visitor has not vanished from sight, in the grand attractions of the celestial sphere.

The right ascension of Venus is 17 h. 5 m.; her declination is 24° 18′ south, and her diameter is 63·8″.

Venus sets a few minutes before five o'clock in the evening; at the end of the month she rises about a quarter before five o'clock in the morning.

JUPITER

is morning star until the 18th, and evening star the rest of the month. On the 18th, at 2 o'clock in the morning, the grand epoch in his career occurs, for he comes into opposition with the sun. Our little earth lies then directly between the sun and the member of his family most resembling him in size and chaotic condition. The giant planet is then at his nearest point to us, and appears in his brightest phase, rising at sunset and continuing visible the entire night. He has found many admirers during November among those who have wakened from their slumber to look at the comet. The prince of planets is a great comet disturber, and has introduced several comets into the system. For the attraction of his huge mass, when they unwittingly came near him, has bent their orbits into an ellipse, and will compel them to travel within the boundaries of the solar system until they come under some other influence, break in pieces like Biela's comet, or dissolve in meteoric showers, the probable fate of comets and meteors.

This superb planet will be in excellent condition for observation for several months. Near opposition he casts a shadow in a darkened room, and instances are on record where he has been seen with the naked eye in high, clear sunshine. It is a good time too for the telescopist, who will find one of the most diversified scenes the heavens present pictured before him, in the noble planet, with his belts and spots, and in the incessant changes taking place among his satellites as they overtake, pass, meet, hide, and recede from each other in endless masses. The bright star rising in the east as soon as the sun has set will be a beautiful object through the month. At its close, Venus will rise an hour before Jupiter sets, and the two planets, one in the east and the other in the west, will be rival attractions in the morning sky.

The right ascension of Jupiter is 5 h. 53 m., his declination is 23° 3′ north, his diameter is 45·2″, and he is in the constellation Gemini.

Jupiter rises about a quarter before six o'clock in the evening; at the end of the month, he sets at twenty-one minutes after six o'clock in the morning.

SATURN

is evening star during the month, and wins the third place on planetary records. He pursues the even tenor of his way as a serene beaming star of great brilliancy, and still maintains his position in the vicinity of the Pleiades, being thus easily recognized. He is now a splendid object in the telescope as he lies cradled in his widely open rings, surrounded by his moons. Our sun may shine as a star, a dot in the Milky Way, to worlds revolving around other suns, but the pride of the solar family, the ringed planet Saturn, can never be visible to any system of worlds outside our own.

Saturn's right ascension is 3 h. 18 m., his declination is 15° 48′ north, his diameter is 19″, and he is in Taurus.

Saturn sets at half past five o'clock in the morning; at the end of the month, at twenty-three minutes after three o'clock.

NEPTUNE

is evening star during the month, and is very near Saturn, making his transit fourteen minutes earlier.

Neptune sets at a quarter after five o'clock in the morning; at the end of the month, at eleven minutes after three o'clock.

URANUS

is morning star during the month, and reaches his quadrature or half way house on the western side of the sun on the 15th, at 1 o'clock in the morning. He is far away from the other three members of the outer planetary group. His right ascension is 11 h. 35 m., his declination is 3° 28′ north, his diameter is 3·6″, and his place is in Virgo.

Uranus rises about thirty-seven minutes after midnight; at the end of the month, he rises about a quarter before 11 o'clock in the evening.

MARS

is evening star until the 10th, and morning star the rest of the month. On the 10th he is in conjunction with the sun, and commences the long path leading to his opposition in January, 1884, for the earth has to revolve twice around in her orbit, and then travel fifty days more, to come into line between the sun and Mars. On the 5th, the day before the transit, Mars is in close conjunction with Venus, passing 6′ south, but both planets are too near the sun to be visible.

Mars sets now about half past four o'clock in the evening; at the end of the month he rises a few minutes after seven o'clock in the morning.

MERCURY

is morning star until the 16th, and evening star the rest of the month. He is a busy member of the solar fraternity at present. On the 9th he is in conjunction with Venus, passing 1° 12′ south. On the 14th, at midnight, he is in conjunction wth Mars, passing 39′ south. On the 16th, at midnight, he is in superior conjunction with the sun, passing to his eastern side and becoming evening star.

Mercury rises at half past six o'clock in the morning; at the close of the month he sets at ten minutes after five o'clock in the evening.

THE MOON.

The December moon fulls on the 24th, at fifty-seven minutes after 10 o'clock in the morning. The old moon passes near Uranus on the 3d, near Venus on the 9th, near Mercury and Mars on the 10th. The new moon of the 10th is in conjunction with Neptune and Saturn on the 21st, and with Jupiter on the 23d, the day before the full. Planet and moon will be at their nearest point about half past nine o'clock, Jupiter passing 2° 39′ north. Once more our neighbor, the moon, tries to prove that she is not a member of the dead world brotherhood to which she has been ruthlessly consigned. Trouvelot, a keen observer, and one of the most reliable astronomers of the day, adds his weighty testimony to the theory that there are signs of life on the lunar surface. He has detected something like thin clouds floating over the moon's disk, and rendering portions of it indistinct, the semblance of a rare vapor slightly tinged with purple rising around the crater Kant, and still another large crater glimmering with a faint purple light.

Sensitive Gas Flames.

In the *Journal de Physique*, M. Neyreneuf also describes an arrangement for producing a sympathetic flame. He remarks that the sympathetic flame of Count Schaffgotsch only gives one tone, having a determinate relation with that of the pipe which envelops it. It is possible, as M. Neyreneuf has shown, to obtain a naked flame capable of giving a series of sounds, and consequently of repeating an air whistled at a great distance. It will suffice for this purpose to cause two flames to strike against each other, or even a flame against a current of air. This takes some time to regulate, in order to obtain the best results; and it is better to have recourse to the following arrangement, which fulfills all the necessary conditions:

A copper tube, 0·25 meter long and 33 milimeters in diameter, is to be fixed vertically. By the lower opening must now be introduced, almost horizontally, the flame of a jet having a hole 2 millimeters in diameter. A shock is thus produced against the side of the tube opposed to the jet, at the same time that a draught of air is drawn into the tube, which thus acts as a chimney. By this means may be obtained, as with the older arrangement, spontaneous tones of great purity, or echoes of remarkable intensity. The two series of sounds may even coexist, and in this case the phenomenon is complicated by the formation of resultant sounds possessing great energy.

Curious Patents.

Some investigating person has furnished the New York *Times* with a brief list of patents on small things which in many instances have proved great mines of wealth to the lucky discoverer. The list might be extended to a much larger number, but we only state those given in the *Times*. Among these trifles is the favorite toy—the "return ball"—a wooden ball with an elastic string attached, selling for ten cents each, but yielding to its patentee an income equal to $50,000 a year. The rubber tip on the end of lead pencils affords the owner of the royalty an independent fortune. The inventor of the gummed newspaper wrapper is also a rich man. The gimlet pointed screw has evolved more wealth than most silver mines, and the man who first thought of putting copper tips to children's shoes is as well off as if his father had left him $2,000,000 in United States bonds. Although roller skates are not so much used in countries where ice is abundant, in South America, especially in Brazil, they are very highly esteemed, and have yielded over $1,000,000 to their inventor. But he had to spend fully $125,000 in England alone fighting infringements. The "dancing Jim Crow," a toy, provides an annual income of $75,000 to its inventor, and the common needle threader is worth $10,000 a year to the man who thought of it. The "drive well" was an idea of Colonel Green, whose troops, during the war, were in want of water. He conceived the notion of driving a two-inch tube into the ground until water was reached and then attaching a pump. This simple contrivance was patented after the war, and the tens of thousands of farmers who have adopted it have been obliged to pay him a royalty, a moderate estimate of which is placed at $3,000,000. The spring window shade yields an income of $100,000 a year; the stylographic pen also brings in $100,000 yearly; the marking pen for shading in different colors, $100,000; rubber stamps the same. A very large fortune has been reaped by a western miner, who, ten years since, invented a metal rivet or eyelet at each end of the mouth of coat and pants pockets to resist the strain caused by the carriage of pieces of ore and heavy tools.

Value of Government Property.

Probably but a very few persons realize the aggregate value of the Government property located at our capital. A correspondent of the New York *Tribune* communicates from Washington a transcript from the official assessment, in which it appears that the Capitol building is assessed at $15,699,556, and the grounds at $7,907,595 ; the White House at $734,590, and the Executive stables at $28,500. The Treasury Department building and grounds are assessed at $7,008.454; the State, War, and Navy Department buildings, $6,211,161 ; the Agricultural Department building, $331,825, and the grounds, $689,086 ; the Smithsonian, $492,651, and National Museum, $250,000, and the grounds, $2,553,378; the National Monument grounds, $1,815,781, and the Washington Monument, $300.000 ; the National Observatory grounds, $125,861, and the building, $255,284; the Patent Office building and grounds, $3,754,883; the Arsenal buildings, $233,324, and grounds, $1,221,607 ; the Marine Barracks ground, $31,235, and buildings, $329,637; the Naval Hospital, $7,198,128 ; Bureau of Engraving and Printing, grounds, $27,612, building, $327,537; Winder's building, used by Engineers' Bureau of the Army, $214,367; United States Medical Museum, $96,280; General Post Office, ground, $312,492, building, $2,124,500; Government Printing Office, $236,000 ; Judiciary Square and City Hall, $1,399,713 ; United States Jail, $525,550 ; United States Navy Yard, ground, $1,413,500, buildings and wharves, $3,615,808; Botanical Gardens, grounds, $1,462,251, buildings, $556,676, hot houses, $58,598. The Aqueduct is valued at $3,847,547, and water pipes and plugs, $172,276. The intersections of streets, circles, and spaces are put down at $4,682,942. The Department of Justice, ground, $150,000, and building, $150,000 ; the Government Insane Asylum, $1,349,775; the Reform School, $221,056 ; the Soldiers' Home, grounds, $333,947, buildings, $350,000; Naval Magazine, $95,000 ; the Georgetown Post Office and Custom House, $63,767.

Imitation of Glycerine.

In the *Union Medicale et Scientifique du Nord-Est*, Prof. Lajoux points out a fraudulent substitute for glycerine, which has been introduced into the French market. The ordinary physical character of the liquid closely resembles a fine specimen of glycerine; it, however, has a bitter taste, due to an impure sulphate of magnesium, and contains glucose. Quantitative analysis showed that the preparation was simply a saturated solution of sulphate of magnesium, with 160 grammes of glucose to the liter, to disguise the taste of the salt.

An Aerial Electric Light.

An interesting experiment has been made in Paris by M. Mangin, a member of the Académie d'Aérostation. A small balloon, measuring about 100 cubic feet, and filled with pure hydrogen, was sent up, being held captive by a rope containing two copper wires. A Swan incandescent light having been placed in the gas and attached to the top of the balloon, was lighted, and the whole aerial machine was splendidly illuminated. It was shown by systematic interruptions that the dots and dashes of the Morse system could be imitated for giving military signals at a great distance.

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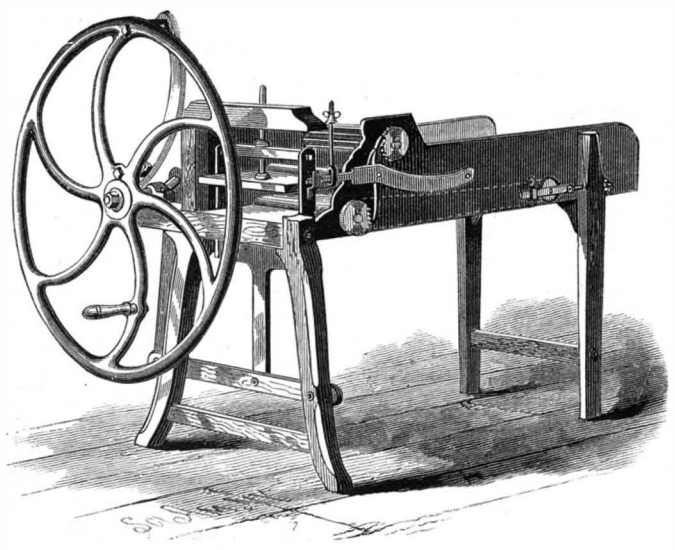
IMPROVED STRAW CUTTER.

We give an engraving of an improved feed cutting machine recently patented by Mr. Peter Stuerholdt, of Stillwater, Minn. In this machine a vertically reciprocating press operates in conjunction with the knife attached to and rotating with the fly wheel, the object being to provide a press actuated from the main shaft of the machine, and reciprocating simultaneously with the revolution of the fly wheel carrying the knife, so that the press will descend and compress the material as it is fed to the knife, just before the knife begins to cut. After the stroke and passage of the knife, the further revolution of the fly wheel raises the press and opens it for the passage of straw through the jaws of the box. An endless apron, carrying and feeding the straw to the knife, is moved by drums, and the forward drum is provided on its outer axis or journal with a ratchet wheel, which is actuated by the lower arm of the pawl. On the outside of the box of the machine is a lever, pivoted to the side of the box. This lever receives its motion from the press slide, and communicates motion to the feed mechanism through the pawls above mentioned.



STUERHOLDT'S STRAW CUTTER.

Inside the box and at a suitable distance in the rear of the press and over the apron there is a feed roller, which is ribbed on its surface longitudinally, and is provided on its outer journal with a ratchet wheel which is engaged by the pawl carried by the side lever.

This machine is rapid in its operation, and simple and inexpensive in its construction.

Compressd Air Engines in Tunnels.

M. Mekarski, well known in connection with compressed air tramway engines, has published calculations to show that compressed air could not be used for the Channel Tunnel except at some difficulty. With a pressure of 5 kilogrammes per square millimeter, and an average temperature of 15° C., the work of the compressed air, expanding two and a half times, would be 11,179 kilogrammeters, and the consumption of air per hour per horse power would be 24·15 kilogrammes. For one passage through the tunnel, the consumption of air at ordinary pressure would be 64,915 kilogrammes, or 177 cubic centimeters, at a pressure of 30 atmospheres. Placing the latter figure at 200 for safety's sake, and computing the weight of the reservoirs to carry the compressed air at 600 to 700 kilogrammes per cubic meter, we should have a total weight of the tender containing the necessary compressed air of 200 tons, which would reduce the load carried from 400 tons, as supposed in his calculations, to 200 tons. M. Mekarski proposes instead, to use the ordinary locomotives, and to run them with a mixture of air and steam. He carries the air in reservoirs—capacity 20 cubic meters—at a pressure of 35 kilogrammes per square inch. These reservoirs communicate with the boiler through an automatic device, which allows the air to enter it only when steam pressure falls below a given minimum. An auxiliary pipe from the air reservoir is to be conducted under the grate, in order to increase the rate of combustion if necessary. The engineer runs the locomotive with a growing quantity of air as he gets farther into the tunnel, and thus M. Mekarski thinks he could reduce the quantity of coal burnt in the tunnel.

Bleaching of Silk.

In this process the silk to be bleached is dipped in a more or less concentrated solution of bromine, according as the coloring matter is stronger or weaker. The duration of the immersion amounts to thirty minutes. After the silk has been drained, it is conveyed to a second bath, which consists of some dilute acid. After the expiration of about half an hour the goods are taken out and again left to drain off. Frequently two or more bromine baths, with as many succeeding acid baths, are necessary. Tartaric and citric acids furnish the best results; moreover, they can also be replaced by alkaline solutions, for which purpose sodium carbonate is best fitted. Sulphates and acid sulphates, as well as sulphuric acid, are likewise suitable for the second bath.—*Palangie and Bedu.*

ELECTRICAL APPARATUS FOR STOPPING STEAM ENGINES.

The object of this invention, by Duncan Bros., London, is to automatically close the valve of a steam engine, and therefore stop it; and to do this in the quickest possible manner the inventor has had recourse to a very simple electrical expedient.

The apparatus shown in Fig. 1 consists of an electro-magnet, battery, and wires leading to any position from which it may be desirable to control the engine, and press buttons for completing the circuit. Also a small steam cylinder, piston, and rack and pinion gearing, which actuates the stop valve on the engine.

The electro-magnet is placed at the top, and connected, as may be seen more plainly in Fig. 2, to a suspension rod which actuates a small steam cock on the cylinder of the apparatus. When it is desired to put the apparatus in operation, the pressure of the finger on one of the buttons—at any distance from the engine—closes the circuit, excites the electro-magnet, and causes it to lift its armature and release the suspension rod, which falls with a velocity due to its own weight. The suspension rod in falling opens the small cock on the cylinder and admits steam, the initial pressure of steam being the same as in the steam engine cylinder. The piston in the cylinder of the apparatus immediately ascends and the rack piston rod instantly closes the engine stop valve.

The steam to work the apparatus being taken from the stop valve chamber from underneath the valve—*i. e.*, between the valve and the steam engine cylinder—the consequence is that as soon as the stop valve has been closed there is no longer any pressure in the small cylinder; and when it is desired to start the engine the engine driver has simply to lift up the suspension rod to its normal position and open the stop valve in the ordinary way. In lifting the suspension rod the small cylinder cock is again closed against the admission of steam, but the cock having three passages is opened for the inlet of atmospheric air. The act of opening the stop valve by the hand wheel operates also on the piston, which falls to the lower end of the small cylinder and is then reset for further use.

When applied to the stop valves of condensing engines, a cock fitted on a pipe opening to the atmosphere is also actuated by the apparatus, and at the instant the stop valve is closed this cock is opened, thus admitting air into the condenser, destroying the vacuum, and stopping the supply of water.

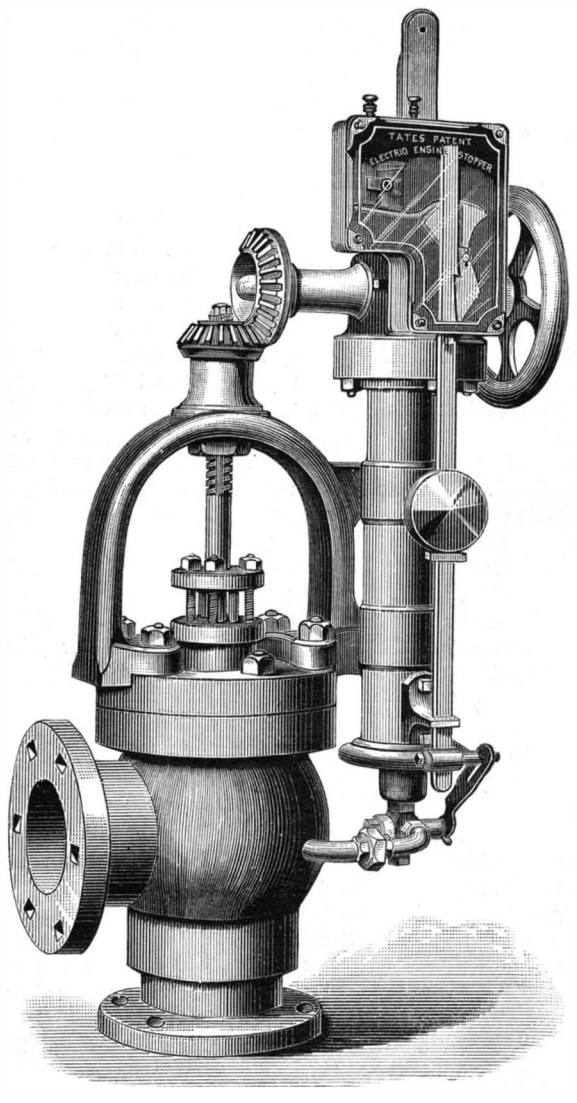


Fig. 1.—ELECTRICAL STOP DEVICE FOR STEAM ENGINES.

The apparatus also stops the engine on which it is fitted whenever the speed exceeds the ordinary rate by any given number of revolutions. This is effected by means of the throttle, or variable expansion valves, actuated by the engine governor. Short arms are fixed on the valve spindles which act as fingers to press in a push or button at any time the valve exceeds the usual range of lift or stroke.

By looking at Fig. 2 the action of the apparatus will be clearly seen. The suspension rod, E, is held in position by the tooth in the locking piece, D. The cam-shaped piece, C, is kept back by the end of the armature, A, which is lifted when a current is passed through the electro-magnet, M. When this occurs, C falls over by its own weight, and striking a projection on the back of D knocks this locking piece away, and the suspension rod thereupon falls and performs the operation assigned to it. As far as the parts of the apparatus directly actuated by the electric current are concerned, they are of the most simple character, and there is apparently nothing liable to get out of order. It is oftentimes, says the *Electrical Review*, very important that engines shall be quickly stopped, and we cannot conceive a more simple or more effectual way than that devised by Mr. Tate. It is stated that this invention "brings within the reach of any person on board ship the power of stopping the engines at a moment's notice, and thus averting the dangers of accidents due to collisions and grounding. On every deck and in every compartment of the ship buttons can be placed (protected by glass covers), communicating with the electric battery, which by means of an electro-magnet actuates the valve-closing motion."

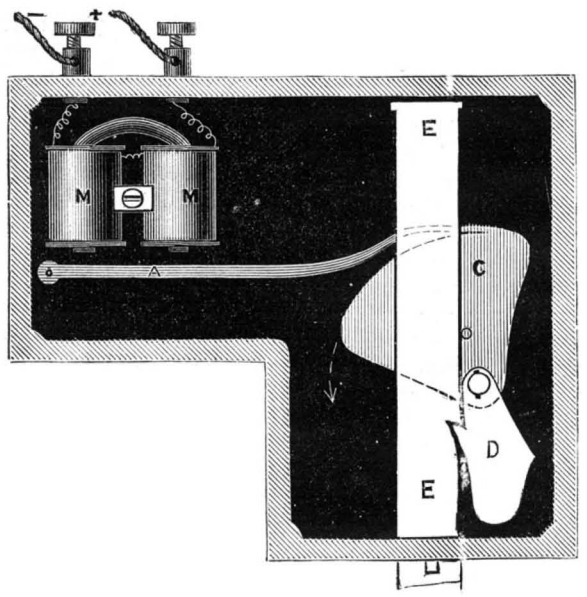


Fig. 2.—ELECTRICAL STOP DEVICE FOR STEAM ENGINES.

Strange Habit of Metapodius Femoratus, Fab.

The "thick-thighed metapodius" is a common insect in the Southern cotton fields, attracting attention by its buzzing flight and ungainly form. The numerous observers connected with the cotton insect investigation have observed it preying upon the cotton caterpillar, while Glover states that it has been observed to injure cherries in the Western States. Mr. Schwarz informs me that he has seen it sucking the moisture from the newly dropped excrement of some unknown bird. Its eggs, according to Glover, are smooth, short, oval, and have been found arranged around a pine leaf like a bead necklace.

In May of the present year, while studying the Northern army worm (*Leucania unipuncta*) in the wheat fields near Huntsville, Alabama, I found that among the other new natural enemies which this Southern irruption occasioned the metapodius was very conspicuous. Immediately upon entering the fields I was struck with its buzzing flight, and it was not long before I discovered one flying with an army worm impaled upon its beak. Watching its flight I soon saw it alight in the line of May weed (*Maruta cotula*) which surrounded the field, and hastening to the point, found it busily engaged in sucking the blood of the captured worm. I was about to step closer and bottle the specimen, when it began to crawl down the branch upon which it had alighted, with that ridiculously slow and majestic motion peculiar to Reduvius and other Heteropters, until it reached a crotch, where it dropped the shriveled corpse of the worm so that it hung exactly suspended. Up to this time I had been so interested in watching this individual that I had not looked about me closely, and now I was surprised to find that the whole long line of May weeds was fairly garnished with the empty skins of Leucania larvæ, each one hung with great nicety in some crotch. This same field I visited for three successive days, and in that time there was quite a perceptible increase in the number of the worms so placed. The sight of these suspended larvæ was certainly one of much interest, and, without seeing the great bug at work, I might have puzzled over it for a long time without any satisfactory explanation.

I shall not attempt to explain this curious procedure on the part of the metapodii. It is seemingly as unexplainable as the somewhat similar habit of the Southern loggerhead or shrike in impaling insects and other small animals upon thorns and sharp twigs. The worms are useless as further food, and certainly cannot be used as nidi for the eggs of the destroyer.—*L. O. Howard, American Naturalist.*

PROFESSOR FREEMAN, of the Johns Hopkins University, of Baltimore, concludes, from a long series of experiments, that electricity is not demonstrably disengaged by the evaporation of fluids.

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IMPROVED RAILWAY CAR.

We give an engraving of an improved railway passenger car designed to avoid telescoping and the disastrous consequences that result from it in the event of a collision.

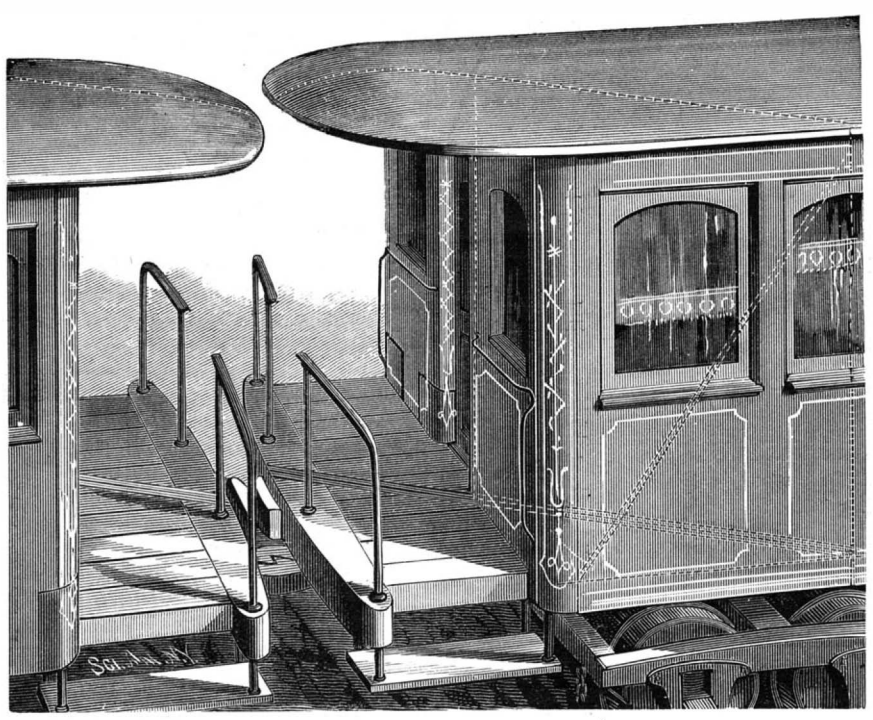
The invention consists in making each end of the car with a corner, which is wholly independent of the frame timbers of the main structure, but fastened to it so as to fill out the proper outline of a car. This detachable part, by being disconnected or displaced in the shock of a collision, allows the ends of the cars to wedge past each other, instead of telescoping into each other, thus avoiding the great loss of life and the injury which are the usual results of telescoping.

It also diminishes the liability to fire from the displacement of the stove or heater, as these will be placed in the solid part of the end of the car.

Referring to the engraving, it will be seen that the car structure is as usual, except that the obliquely opposite corners on opposite ends, as shown, are framed independently, and attached to the main frame in such manner as to fill all the usual requirements of a passenger coach; but so that in case of a collision and tendency to telescope the corners, by reason of their being weaker than the opposing side of the next car, will be broken off, and should they not have sufficient strength to destroy the momentum of the car, the oblique side or framework, coming in contact with the re-enforced guard or fender on the opposite car, will divert the car from its course and render telescoping impossible. The timbers forming the oblique side or end of the main frame are strongly fastened to the main frame, and the corresponding timbers, which are a part of the frame of the corner, are bolted to the timbers in such manner as to afford sufficient strength for common use, but of just such strength as will give way in the event of a collision. The corner of the car, attached as shown, is supported vertically by the superstructure and by rods. Iron guards or fenders made very heavy are strongly fastened into the bottom timbers of the car, and extend high enough above the platform to receive the force of the colliding cars. These guards may, however, be omitted. They are built in with the wooden framework to supplement its strength, but will not be seen, except where the flange extends a short distance inside of the doorway. These guards afford greater strength to the part of the car inclosing the stove.

In ordinary collisions the momentum of the cars would in a great measure be overcome in crushing off the corners, and in severe collisions the cars might be derailed, but with greatly reduced tendency to loss of life.

This invention has recently been patented by Mr. John Milton, of Hamilton, Va.



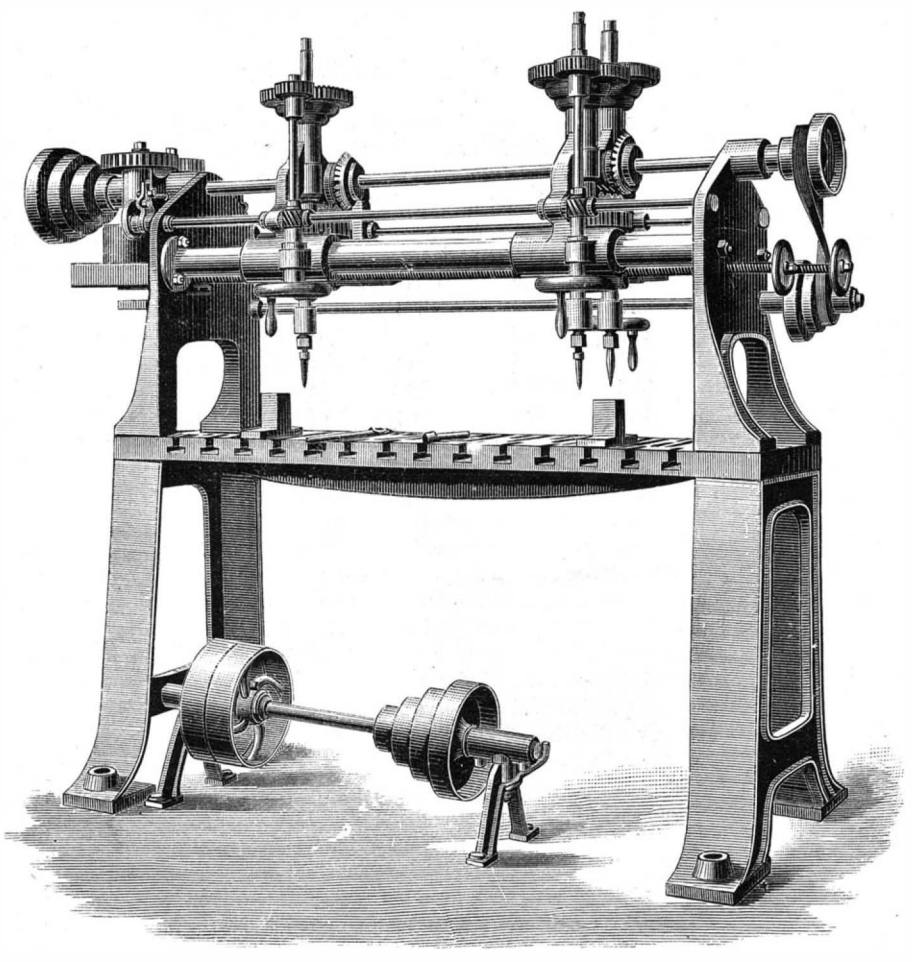
MILTON'S IMPROVEMENT IN RAILWAY CARS.

MULTIPLE-SPINDLE SLOT DRILL.

This machine, constructed by Beverley & Atkins, Sheffield, is capable of finishing a complete set of keyways, three in number, at one operation, and thus economizes both time and labor.

The machine has two movable heads, one of these—that to the right hand in our engraving—carrying two drill spindles, each 1½ inches in diameter, while the other head carries a single spindle. This arrangement is adopted, says *Engineering*, because one of the shafts of a wringing machine roller has a keyway at one end only, but it is of course capable of modification if the machine is intended for other purposes. The traverse of the heads, which is given by elliptical gearing so as to equalize the motion, is adjustable up to a range of 4 inches, while the position of each head between the frames can be modified independently of the other.

By throwing off the traverse driving belt the machine is converted into an ordinary drill with three spindles. The down feed in slot drilling is self-acting, and is given by ratchets and spiral wheels, there being two speeds. It will be noticed that the framing of the machine is open at each end so as to allow of a long shaft being operated upon. The whole machine is of a new type and one which can be very readily modified to suit the requirements of various manufacturers.



IMPROVED SLOT DRILL.

Pure Hydrochloric Acid.

The author adds to the sulphuric acid employed a small quantity of an oxidizing agent, such as potassium bichromate or permanganate, and causes the gas, before it is conducted into water, to pass over mercury in a Liebig's bulb tube. The oxidizing body prevents the formation of sulphurous anhydride in presence of organic matter, and liberates bromine and iodine if present. Arsen-chloride is decomposed in contact with the mercury, and free chlorine, bromine, and iodine are absorbed.—*Dr. Giudice.*

Railways for Common Wagons.

An experiment of more than ordinary significance is about to be tried in England. A number of leading ship owners and merchants of Liverpool have projected and raised a large guarantee fund for obtaining parliamentary sanction for a series of roadways, radiating from Liverpool to the great centers of manufacturing industry in South Lancashire, the roads to be laid with a double set of iron plates to serve as tracks for ordinary freight wagons, the wagons to be drawn by steam traction engines. It is expected that goods can be transported in this way at a much lower rate than the present cost of railway transportation.

The chief saving will be in the handling of goods. The wagons, which will be similar to those in general use on ordinary roads, except that the axles will be of the same length, will be loaded directly from the steamer or the factory, drawn by horses to the nearest station of the "plateway," and there attached to a long line of similar vehicles with an engine at its head. Arrived at their destination, horses will draw them to the factory or steamer. The metal plates will be laid in two parallel rows, with low flanges on the outer edge to keep the wagons on the track. It is thought that $175,000 a mile will construct and equip the plateway, and that the cost of maintaining and operating it will be comparatively small.

The Princeton College Scientific Expedition.

The scientific expedition which left Princeton, June 26, secured twenty-two hundred pounds of valuable fossils, which have been classified and added to the college museum. The collections were made in Wyoming, Nebraska, and Dakota.

Selenium.

This rare element, which a few years ago was a mere chemical curiosity, has since become a commercial article. It is not yet sold by the ton, it is true, but it is no longer impossible to obtain a pound of it, even in this country.

The cause which has operated to bring so scarce a substance into the market is to be found in the fact that many amateur and practical electricians are endeavoring to utilize a property which is not known to exist in any other substance, viz., that of changing its electrical conductivity when exposed to the light. Like sulphur and phosphorus selenium is able to exist in different allotropic forms, only one of which possesses this interesting (and probably useful) property, viz., the crystalline form. Fortunately the amorphous selenium is easily rendered crystalline by heating or fusing, and permitting it to cool very slowly. Selenium possesses a striking similarity to phosphorus in its relation toward sulphide of carbon, although, in all cases, less soluble in that liquid than in phosphorus, but its solubility does not depend entirely on whether it is crystalline or not, for the amorphous variety deposited from selenide of hydrogen is soluble, and so are the monoclinical crystals. As these crystals are only obtained from solution, we can readily understand why they are soluble, and it is not probable that any real difference exists between them and the soluble form of amorphous selenium. When these crystals are heated to 150° C (302° Fahr.), they turn black and become insoluble, but this selenium recovers its solubility by melting and *rapid* cooling, which is certainly rather surprising. The solubility of selenium in sulphide of carbon is very small at best, 100 parts being required to dissolve one of selenium at a boiling temperature, so that no practical use can be made of it. The vitreous selenium is still less soluble, while the other forms are all totally insoluble in sulphide of carbon. The best solvent for selenium is its own chloride, which dissolves large quantities of both modifications, but they separate from it as black selenium.

OCCURRENCE.

Selenium, we have said, is not an abundant article, and all now in the market is imported. It has been found in a free state at Culebras, in Mexico, and *Les Mondes* says that an ore containing 28 per cent of selenium has been found in the province of Mendoza, in the Argentine Republic. Clausthalite is as elenide or lead found in the Hartz Mountains. But none of these actually furnish the manufacturer with selenium. Many pyrites, both of iron and copper, contain traces of selenium, which becomes concentrated when the ore is used for other purposes, and may be utilized for making selenium. The soot that collects in the flues of the Mansfeld copper works in Saxony, and the slimy deposit that is found in the leaden chambers of sulphuric acid works where seleniferous pyrites are burned, are among the chief sources of selenium. The chamber deposits at Stockholm in Sweden, in which it was discovered by Berzelius, and at Tilkerode in the Hartz, in which thallium was discovered by Crookes, are among the richest sources of selenium. According to Nilson the chamber deposits from Falun in Sweden contain 2½ per cent of selenium. In 1875 the total amount of selenium produced at Eisleben from Mansfeld soot was only 5¼ lb., valued there at $90. Platinum ores sometimes contain selenium, and a slag containing a large percentage of selenide of sodium is made at the Frankfort assay office as an incidental product. When dissolved in water it yields a reddish brown solution, from which, on exposure to the air, a crust of metallic selenium separates. (*Dingler's Journal*, ccxxiv., p. 414.) A portion of the selenium of commerce comes from this source.

PREPARATION.

The simplest method of preparing selenium from these deposits in the leaden chambers is to digest the slime with a rather strong solution of cyanide of potassium; about one-third of an ounce of the cyanide to a pound of the deposit. After filtering or decanting, the selenium solution is treated with excess of hydrochloric acid, which liberates a quantity of Prussic acid, and throws down the selenium as a red powder or scales. ($SeK_2Cy_2 + 2HCl = 2HCy + 2KCl + Se$.) The gases given off must either be absorbed in water or alkali, or else conducted into a flue, as they are *very deadly!* If any sulphur is dissolved it remains in the solution in form of sulphocyanide, not being so readily decomposed as the selenio-cyanides are.

This method is also very convenient for testing for the presence of selenium in chamber deposits. Such deposits, of

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course, contain a good deal of lead, sulphur, etc., and if selenium is present are generally red. They should be digested with the cyanide solution at a temperature below boiling, until the residue has lost its red color. If no red substance separates on adding an excess of hydrochloric acid, it may be assumed that selenium is absent, or present in too small quantities to pay for working it. If a deposit forms it may be tested as below described.

Another method of making selenium consists in dissolving the slime or sediment in caustic potash, and then exposing the solution to the air at a temperature of 44° Fahr. Hyposulphite of potash is formed, and selenium separates. Mansfeld soot is levigated, washed with water acidified with hydrochloric acid, then with pure water, dried, and fused with crude carbonate of soda, or potash. The selenates are extracted with water, and exposed to the air as before. The fusion, even on a very small scale, *must not be performed in a platinum vessel,* as it always contains more or less lead, which would destroy the crucible.

PURIFICATION.

Selenium prepared by any of the above methods forms red scales. If washed on a filter and then boiled in water, it agglomerates together to a hard, reddish black mass, with a metallic luster and ring. To purify selenium, Bunsen dissolves it in hot nitric acid, which oxidizes it and converts it into selenious acid. By evaporating this *slowly* on a water bath to dryness, he obtains anhydrous selenious acid as a white powder. By too rapid evaporation some of the seleniumi s carried off with the nitrous vapors. The selenious acid is next purified by subliming it in a current of air at, or below a red heat. A piece of combustion tubing is drawn out narrower in the middle, and loosely stopped with a tuft of asbestos; the dry acid is placed in one end, which is heated quite strongly, and other end cooled, while a current of air is drawn through it. Selenious acid sublimed in this way forms beautiful long white crystals. It is next dissolved in water, and a current of sulphurous acid (SO_2) passed through it, whereby the selenium is precipitated as a red powder, which may be melted and cast in moulds if desired.

TESTS FOR SELENIUM.

The characteric odor of burning selenium, resembling, as some say, decayed horseradish, is generally a sufficient test. Its soluble salts give a red precipitate when sulphurous acid is passed through their solutions; if there is but little selenium present, the solution has a *green* appearance by transmitted light. (SCIENTIFIC AMERICAN, Oct. 26, 1872.) Selenium colors the flame a bright blue, which does not serve to distinguish it from sulphur. If a small bit of any selenious compound be brought on an asbestos thread into a small reducing flame, and a glazed porcelain dish of *cold* water be held one-half inch above it, a brick-red film will be deposited on the cold porcelain; heated with strong sulphuric acid, it gives an olive green solution, which yields a red precipitate when poured into water (Bunsen). Selenium does not dissolve in sulphuric acid unless this is very strong, but if boiled in the acid for a very long time, it becomes oxidized to selenious acid, sulphurous fumes are evolved, and no precipitate of red selenium can then be obtained on dilution (Hilger).

MELTING POINT.

We have already seen that selenium can assume various forms or states, some of them soluble and others not; some conduct electricity while others do not. In regard to the melting point of selenium statements are at variance, for it sometimes becomes soft long before it is really fluid. When melted and allowed to cool very slowly, selenium becomes granular, or crystalline, with a leaden gray to reddish violet color. In this form it melts at 217° C (423° Fahr.) without previously softening. According to Bettendorff and Wüllner, the amorphous selenium begins to soften between 40° and 50° C. (104° to 122° Fahr.) Berzelius says it softens when warmed, at 100° C. (212° Fahr.) it is semi-fluid, and perfectly liquid at a slightly higher temperature, but on cooling remains soft, like sealing wax, so that it may be drawn out in long, elastic, transparent threads. Sacc says that selenium has no definite melting point, for it softens and hardens gradually; that it probably melts at 200° C. (392° Fahr.), for at that temperature it ceases to adhere to the bulb of the thermometer. It is completely melted at 250° C. (482° Fahr.), and when cooled to 150° C. (302° Fahr.) it is entirely solid.

ACTION OF LIGHT ON SELENIUM.

This seems to have been first observed by Willoughby Smith and his assistant, Mr. May, in 1874. At first the effect was attributed to heat, but the experiments of Lord Rosse, Werner Siemens, and others, soon demonstrated the fact that it was light, and not heat, that effected this change. Selenium, like most non-metals, is a very poor conductor of electricity; in the amorphous form it does not conduct the current at all, in the crystalline form it conducts the current feebly, but the resistance is less when the selenium is exposed to light than when kept in the dark. Even the cold light of the moon has the same effect as found by Adams. So sensitive can it be made by suitably "annealing," or rather crystallizing it, that Siemens constructed an artificial eye that would wink, while Tainer and Bell have produced sound by the agency of light in their photophone. The latter claims to have made sensitive selenium cells, having a resistance of only 155 ohms in the light, and 300 ohms in the dark. The cells used are made by taking a plate of brass and heating it, then rubbing it over with a stick of selenium. It is annealed by heating it over a gas burner until the reflecting surface becomes dimmed. The cloudiness resembles somewhat the film of moisture produced by breathing on a mirror. Bell says that his best results have been obtained by heating the selenium until it crystallizes, then continuing the heating until it shows signs of melting, when the gas is immediately put out. The portions that had melted instantly crystallize, and the selenium is found, on cooling, to be a conductor, and to be sensitive to light. The appearance of the crystals, seen under the microscope, differs according as the heat is removed, as soon as cloudiness begins, or not until fusion begins, or when complete fusion is followed by slow cooling.

CHEMICAL AND OTHER PROPERTIES.

We have seen that selenium does not dissolve readily except in chloride of selenium. Sulphuric acid, free from water (H_2SO_4), dissolves it, nitric acid oxidizes it, and the alkalies combine with and dissolve it. It unites directly with bromine and chlorine, and on heating, will unite with iodine, sulphur, phosphorus, and the metals. It unites with iron to form a selenide, and when this is decomposed by acid, a hydrogen compound, H_2Se, is formed, which resembles sulphureted hydrogen in its power of precipitating the heavy metals from solution, but is distinguished for its unpleasant odor. Selenium forms nearly all the compounds that sulphur does. Owing to the ease with which it may be liberated from its compounds by reducing agents, it is generally estimated in the free state, by precipitating with sulphurous acid as a red powder, boiling to cause it to adhere together, and collecting it on a tared filter, drying and weighing as such.

ELECTROLYTIC DEPOSITS.

Selenium is easily reduced from its solutions, whether acid or alkaline, by the galvanic current. According to Schucht the deposit is at first light-red, but as it grows thicker becomes darker. The precipitation is so complete that it could be employed for quantitative estimations. Only a feeble current of two elements can be employed, or the selenium would become pulverulent. When deposited on a platinum electrode, it rubs off easily; probably on brass or copper it would adhere better. From its combination with potassium, selenium precipitates nicely with a feeble current; in acid solutions some seleniureted hydrogen is given out at the negative pole. If the solution contains a metal, like copper, the selenium and copper are precipitated together, and the color of the deposit is darker than that of pure copper.

For covering metals with selenium, the method of melting on seems preferable to electrolytic deposition.

NOVELTIES AT THE NEW ENGLAND INSTITUTE FAIR.

The engravings on our front page illustrate the special features of several devices which attracted our artist's attention at the Boston fair, as combining novelty with a promise of considerable economic and industrial value.

Fig. 1 represents the general plan and pulley connections of the Harris Revolving Ring Spinning Frame. The purpose of the improvements which it embodies is to avoid the uneven draught of the yarn in spinning and winding incident to the use of a fixed ring. With the non-revolving ring the strain upon the yarn varies greatly owing to the difference in diameter of the full and empty bobbin. At the base of the cone, especially in spinning weft, or filling, the diameter of the cop is five or six times that of the quill at the tip. As the yarn is wound upon the cone the line of draught upon the traveler varies continually, the pull being almost direct where the bobbin is full, and nearly at right angles where it is empty. With the increasing angle the drag upon the traveler increases, not only causing frequent breakages of the yarn, but also an unequal stretching of the yarn, so that the yarn perceptibly varies in fineness. The unequal strain further causes the yarn to be more tightly wound upon the outside than upon the inside of the bobbin, giving rise to snarls and wastage.

These difficulties have hitherto prevented the application of ring spinning to the finer grades of yarn. They are overcome in the new spinning frame by an ingenious device by which a revolving motion is given to the ring in the same direction as the motion of the traveler, thereby reducing its friction upon the ring, the speed of the ring being variable and so controlled as to secure a uniform tension upon the yarn at all stages of the winding.

The construction of the revolving ring is shown in Fig. 2. C is the revolving ring; D, the hollow axis support; H, a section of the ring frame; E, the traveler.

To give the required variable speed to the revolving ring there is placed directly over the drum, Fig. 1, A, for driving the spindle a smaller drum, B, from which bands drive each ring separately. The shaft, which is attached by cross girts to the ring rail, and moves up and down with it, is driven by a pair of conical drums from the main cylinder shaft; and is so arranged with a loose pulley on the large end of the receiving cone as to remain stationary while the wind is on or near the base of the bobbin. When the cone of the bobbin diminishes so as to materially increase the pull on the traveler the conical drums are started by a belt shipper attached to the lift motion. By the movement of the belt on these drums a continually accelerated motion is given to the rings, their maximum speed being about one-twentieth the number of revolutions per minute as the spindle has at the same moment. This action is reversed when the lift falls. The tension of the wind upon the bobbin is thus kept uniform, the desired hardness of the wind being secured by the use of a heavier or lighter traveler according to the compactness of cop required.

The model frame shown at the fair did its work admirably well, spinning yarns as high as No. 400, a fineness hitherto unattainable on ring frames. It is claimed that this invention can do whatever can be done with the mule, and without the skilled labor which mule spinning demands.

This invention is exhibited by E. & A. W. Harris, Providence, R. I.

Figs. 3, 4, and 5 illustrate some of the applications of the electric stop motion in connection with cotton machinery. The merit of this invention lies in simplifying the means by which machinery may be stopped automatically the instant its work, from accident or otherwise, begins to be improperly done. The use of electricity for this purpose is made possible by the fact that comparatively dry cotton is a non-conductor of electricity. In the process of carding, drawing, or spinning, the cotton is made to pass between rollers or other pieces forming parts of an electric circuit. So long as the machine is properly fed and in proper working condition the stopping apparatus rests; the moment the continuity of the cotton is broken or any irregularity occurs, electric contact results, completing the circuit and causing an electro-magnet to act upon a lever or other device, and the machine is stopped. The current is supplied by a small magneto-electric machine driven by a band from the main driving shaft, and is always available while the engine is running.

Fig. 3 shows the general arrangement of the apparatus as applied to a drawing frame. In the process of drawing down the roll of cotton—the sliver—four things may happen making it necessary to stop the machine. A sliver may break on the way from the can to the drawing rollers, or the supply of cotton may become exhausted; the cotton may lap or accumulate on the drawing rollers; the sliver may break between the drawing rollers and the calender rollers; or the front can may overflow. In each and all of these cases the electric circuit is instantly completed; the parts between which the cotton flows either come together, as when breakage occurs, or, if there is lapping, they are separated so as to make contact above. In any case the current causes the electro-magnet, S, against the side of the machine to move its armature and set the stop motion in play.

Figs. 4 and 5 represent in detail the manner in which electric connection is made in two cases requiring the intervention of the stop motion. In Fig. 4 the upper part of a receiving can is shown. When the can is full the cotton lifts the tube wheel, J, until it makes an electrical connection, and the stop motion is brought into instant action. In Fig. 5, the traction upon the yarn holds the hook borne by the spring, F, away from G, and the electric circuit is interrupted. A breakage of the yarn allows this spring to act; contact is made, and the stop motion operates as before.

This simple and efficient device is exhibited by Howard & Bullough & Riley, of Boston.

Fig. 6 shows the essential features of a positive motion loom, intended for weaving narrow fabrics, exhibited by Knowles, of Worcester, Mass. The engraving shows so clearly how, by a right and left movement of the rack, the shuttle is thrown by the action of the intermediate cog-wheels, that further description is unnecessary.

THE NATIONAL ACADEMY OF SCIENCES.

The annual meeting of the National Academy of Sciences began in this city November 14, Professor O. C. Marsh, of Yale, vice-president of the Academy, in the chair.

In the first paper Professor Loomis, of New Haven, discussed the mean annual rainfall of the several geographical divisions, and pointed out that on our Atlantic coast an annual rainfall of at least fifty inches extends from latitude 35° north to latitude 33° south. In the principal part of South America a rainfall of fifty inches extends nearly to the Andes, and there are extensive districts which have a rainfall of seventy-five inches. In Africa there is a rain belt of fifty inches, whose average breadth is 1,000 miles, and which is apparently continuous from ocean to ocean. There are also extensive districts where the annual rainfall exceeds seventy-five inches. In nearly all the islands of the East Indian Archipelago the mean rainfall exceeds seventy-five inches. We have thus an equatorial rain-belt amounting to at least fifty inches annually, having an average breadth of nearly 1,500 miles, and which appears to be continuous across all the islands and continents. With regard to the ocean our knowledge is very limited. As we recede from the great equatorial rain-belt, the amount of the rainfall diminishes rapidly, with the exception of certain districts of limited extent, where local causes give rise to a large rainfall.

Very large portions of the globe have an annual rainfall of less than ten inches. In North America such a region is found in Southern California and Arizona, and there is a large district about Slave Lake where the annual precipitation is only about ten inches of water, and is apparently less than that amount. In South America such a region is found on the west side of the Andes. In Europe there is no district having so small a rainfall as ten inches, except in Spain. In Asia there is such a region, 3,000 miles long and 1,000 broad. In the northeastern part of Asia there is also an extensive region where the precipitation scarcely exceeds ten inches. There are also large stretches of country nearly rainless in Africa and Australia. Thus we find that about one-fifth part of the entire land surface of the globe has a rainfall less than ten inches, and a still larger portion has a rainfall so small as to render it valueless for agricultural purposes, except in those limited districts which allow irrigation.

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Professor Ira Remsen, of Baltimore, next reported the accidental discovery of a new form of phosphorus. To obtain some pure phosphorus he tried an improved method of distilling, using pure hydrogen and condensing the phosphorus vapor in a glass retort.

He obtained a soft, plastic, pure white form of phosphorus lighter than water. He thinks the new form is due to mechanical rather than chemical changes.

Professor C. A. Young, of Princeton, showed how he had preserved his prisms from undue heating when making observations with the telescope of 23-inch aperture, by straining out the heat-rays by means of a stream of water between the lenses of the eye piece.

Professor S. H. Scudder, of Boston, described an interesting conflict of animal and vegetable evidence found in geological formations, near Fairplay, Colorado. He said:

The plants have been pronounced permian by Leo Lesquereux. The animal remains consist almost exclusively of insects which belong to types of a far more modern character than any the palæozoic series has yet disclosed. All but one or two belong to a group which, of all palæozoic insects, has received the most attention, namely: the cockroaches. While this fact of the great preponderance of cockroaches, and the further fact that the few known genera found in this collection have hitherto been discovered only in carboniferous and permian rocks, would lead us at first to refer the beds in which they occur to one of the palæozoic series, the presence of the other forms, and even the characteristics of those which are referable to carboniferous and permian genera, unmistakably point to a later origin.

The palæozoic cockroaches are distinguished from living species by having five veins in the wing instead of four. For these ancient forms the name of palæoblattariæ has been proposed. Eleven out of the seventeen species found at Fairplay belong to this class. Only four of the eleven belong to known species, and one of these is doubtful. The average size of the Fairplay palæoblattariæ is much less than that of the palæozoic members of the group. The six species which do not belong to the palæoblattariæ show strong resemblances to the mesozoic cockroaches. They all have a decided mesozoic aspect, and would be at once considered Triassic, or at least Jurassic, by any one familiar with the forms already known from these deposits. Only one of these species resembles any one of the palæoblattariæ. This resemblance is of especial interest because it points out the methods in which the change from palæozoic to mesozoic forms is made.

The facts that have now been brought forward, show that in this locality at Fairplay we have an assemblage of forms altogether different from anything hitherto found in the palæozoic series on the one hand, or the Jurassic beds on the other. They indicate that the beds in which they belong are Triassic. If this is true, the discovery will have an added interest from the fact that little is now known of the plants or insects of this period.

Professor Guyot, in a paper presented by Professor Marsh, offered an explanation of the causes of the dry zones in both hemispheres which Professor Loomis had described. These zones were found in the sub-tropical regions, where the rainfall is usually greatest.

The first of these zones appears very generally around the globe between the twenty-eighth and thirtieth degrees of north latitude, beginning in Southern California and continuing in Sahara, Arabia, Afghanistan, and across a portion of the Malay peninsula. The second zone he marked on the southern hemisphere, beginning in Peru, appearing again in the Argentine Republic, and again noticeable in South Africa to the north of the Hottentot country, and then in the northern section of Australia.

The cause of these dry zones Professor Guyot finds in the fact that on the regions in question during the continued dry seasons there is a "descending wind." The counter currents from southwest and northeast cause an ascension of the air at the Equator, and these waves, as they may be called, descending, again take up the heat lost in altitude, and are subjected to such a pressure that they give up none of the moisture they contain. This accounts for the fact that although these waves are frequently cloud laden there is no precipitation.

A discussion of the paper followed, in which Professor Hunt, of Montreal, Professor Brown, and Professor Newberry gave isolated facts within their personal experience, which tended to strengthen the views advanced by Professor Guyot.

Of the papers presented the second day only two were of general interest. Mr. G. F. Becker, of the U. S. Geological Survey, discussed the current theories of the source of the heat of the Comstock Lode; recited observations and experiments tending to disprove the theories that the heat is caused by chemical action in the decomposition of pyrites and in the kaolization of feldspar; and gave his reasons for believing that the heat is of volcanic origin.

The longest and most interesting paper of the day was by Professor A. E. Verrill, of Yale, discussing the physical and geological character of the sea bottom off our coasts, especially beneath the Gulf Stream.

The paper embodied the general results of observations covering a period of eleven years, including dredgings by the United States Fish Commission, taken from over 2,000 stations between Chesapeake Bay and Labrador, and out as far as 150 to 200 miles off shore. Professor Verrill and his associates of the Commission found in these observations that from the shore to a point about 60 miles out the water is inhabited by animals representing arctic life, similar to those found off the coast of Greenland, Spitzbergen, and Siberia. Beyond this lies a warm belt of water which is inhabited by tropical or sub-tropical animals. This warm belt varies with the shore-line of the coast, and while its eastern edge is within 60 miles of Nantucket and Martha's Vineyard, it is much further off from the coast of Massachusetts and Maine, as what is known as the Gulf of Maine is a cold body of water, outside of which lies the warm belt. This warm belt is about 25 miles in width. In this the temperature from a depth of 65 fathoms out to the limits, where the soundings show a depth of 1,000 fathoms, is from 46° to 52° Fahrenheit near the surface, decreasing in temperature in the lower soundings, until at 700 fathoms it is 39°. In the cold belt the temperature of the water ranges from 35° to 45° in August below the surface water, which is in the autumn warmer than that underneath. The temperature at 40 fathoms in the cold belt averages from 35° to 37°. In the warm belt the temperature at 65 fathoms is 46°; at 100 fathoms 50° to 52°; at 200 fathoms 48°; at 300, 40°; and at 700, 39°. As a result of the soundings, measurement of temperatures, etc., it was discovered that an error exists in our maps and charts in placing the warm belt, or Gulf Stream, too far from the shore by 30 or 40 miles. It was also found that the soundings even on the coast survey charts were inaccurate by hundreds of fathoms in many instances, which are now, however, corrected by the coast survey soundings made during the past summer. The generally accepted theory has been that the 100-fathom line marked the line of the Gulf Stream, but this was found to be incorrect, as the line would be more nearly correct if placed at 65 or 70 fathoms line. The charts are also incorrect in that they make out a difference in the line of the Gulf Stream in summer and in winter. The Professor held that there was no variation in the body of the stream, though there is in the surface water an apparent variation, due to the sweeping in of the warm surface water in the summer and the diffusion of the cold surface water over the stream from the shore during the cold months. The proof of his theory is the fact that the sub-tropical life exists in the Gulf Stream in winter as well as in summer, while the character of the inhabitants of the cold belt remains unchanged the year through, and the line of separation between the two kinds of life is well and distinctly marked on the bottom. If there was a variation in the bottom of the stream there would be death to the sub-tropical life of the warm belt.

In the portion of the warm belt south of the New England coast, from 70 to 120 miles from the coast, there was discovered, in 1880, the most valuable ground for the sub-tropical animal life, as prolific in fauna of that class of life as any in the world. From this ground the dredges have taken and brought to the surface 800 species of fauna, over one-third of which were entirely new and unknown to science, including 17 kinds of fishes, 270 of mollusks, and 90 of crustacea. The recent observations of the Fish Commission have been made in a warm belt extending about 160 miles from the northeast to the southwest, and about 20 miles in width. Over 130 dredgings were made in this belt at a depth of 100 fathoms. At about the 100 fathom point the formation of the sea bottom is peculiar in many respects. To this point there is a gradual descent from the shore. Then there is a precipitous descent to soundings of 1,000 fathoms or more, the sudden precipitous descent corresponding to about the height of Mount Washington along the territory that has been explored. The warm belt seems to extend down this precipice only to a depth of about 125 fathoms, judging from the evidences of life brought up in the dredges as well as the thermometrical records. A trawl had brought to the surface in several instances a ton of animal life, which included crabs, shrimps, starfish, and shells of various kinds, among them shells which had hitherto been found only on the shores of the West Indies, but which are now known to be inhabitants of the warm belt of water running along the Atlantic coast. The surface inhabitants are also tropical in their nature, as is shown by the capture of argonautas, Portuguese men-of-war, varieties of the jelly-fish, and pteropods in large quantities. A peculiarity in the weather was noticed by the people engaged in dredging, for while it was pleasant out on the warm belt, they had found on their return to the shore that a storm had been raging, which had caused their associates on shore anxiety as to the safety of their steamer, the Fish Hawk, and the people on board.

The quality and quantity of the light in the depths had not yet been ascertained, but some marked peculiarities have been noticed. Many of the crabs and other animals caught have been found to have the eyes very largely developed. Other animals, which live at greater depths, have been found to be without eyes, presumably a useless organ in the great depths. Another peculiarity observed about the animals found at great depths is that their color is either red or an orange yellow, this being the case with the corals, anemones, fish, and such animals as are exposed to attack from voracious enemies. It is therefore inferred that the color is a mode of defense, in that it renders the animal invisible in the greenish-blue water, and the similarly colored rays of light which can only reach to those depths, and so render a red coat a means for its wearer to keep out of sight of its enemies. The bottom of the Gulf Stream is very peculiar. That of the Arctic belt is a coarse gravel or sand. That of the great depths a sticky mud. Under the Gulf Stream the bottom is of sand of so fine a grain that the grains can only be distinguished from one another under the microscope. This packs together so compactly that the sailors who find it clinging to the sounding leads call it mud. Yet it is the finest grade of sand, very cohesive in its nature. Mixed with it in great quantity are masses of the most minute shells. The two seem to form a bed as level and hard as any floor, and judging from the results of dredging this floor is carpeted thickly and densely with masses of vegetable and animal life. Bowlders are occasionally found on this bottom, and these, the Professor thought, had dropped from cakes of ice that had floated out from the shore. There are also brought out by the dredges occasionally a different form of rock, which seems to be indigenous to the bottom and filled with fossil shells, many of which are exactly like the shells now found on the bottoms. These rocks, he thought, might possibly date back to the pliocene age, but possibly only to the post-pliocene. Their appearance in the dredges he presumed to be due to the fact that they had been loosened from their beds by the burrowing fishes and animals and then caught up by the dredges.

In connection with the character of these fossil rocks he had noticed the absence of all vertebrate fossils. The dredges too, had never brought up any evidence of the existence of dead vertebrates, though the water swarmed with myriads of sharks, dolphins, and other vertebrates, nor had any evidences of the existence of man been brought up in these dredges, and nothing of consequence of man's work except an India-rubber doll, that had been dropped overboard from some vessel. Yet the territory dredged was in the track of the European vessels and where ships have gone down and lives been lost, but everything of this character is destroyed by the voracious animal life of the tract. These facts led him to doubt the negative evidence in geology, and the absence of vertebrates in the early fossil remains found does not lead him to conclude that the mammals did not exist at that time, as their remains might have been destroyed by the animals that have been found in the rocks, as are all evidences of vertebrates in the tract they had been dredging, although it is well known that such animals exist in myriads in the waters above. The presence of broken shells in large quantities on the bottom, he said, was due to the fact that carnivorous crabs and other animals eat the bivalves and univalves alike, cracking up and throwing away the shells. He also stated that the bivalves were food for the cod, which digests out the meat and then spits out the shells.

The third day was devoted mainly to geology and astronomy. Professor Pickering of Yale presented a plan for co-operation in the observation of variable stars. Professor Young made an address on the importance of the solar eclipse of May 8, 1883, and Mr. Chas. H. Rockwell, of Tarrytown, presented the advantages of the position of Caroline Island, in the South Pacific, as a station for observing the eclipse, and the cost of an expedition thither. Professors Langley and Newton urged the importance of such an expedition. The important questions which this eclipse may be the means of solving, Professor Young said, are those of the lunar atmosphere, the spectrum of the chromosphere, the nature of the outer violet portion of the spectrum, the polarization of the corona, the relation between the zodiacal light and the corona, the question of the existence of an intra-Mercurial planet. The path of the coming eclipse makes it exceedingly difficult to get at. The time of the eclipse is very important, because it comes at a time when there will be a great deal of solar spot activity. The duration of this eclipse will be unusually great, being about six minutes. Since 1868 we have had none which lasted over four and one-half minutes. Six minutes is nearly the maximum possible duration.

Professor Peters, of Hamilton College, discussed the structure of the present comet, and the conditions which have led to the belief that the nucleus is divided. He had failed to find evidence of such division. He did not believe the comet to be identical with the comets of 1843 and 1880. The present comet appears to have a spiral orbit, and the probability is that it has never been seen before.

Among the geographical papers, the one of widest general interest was that of Professor Newberry, on the physical conditions under which coal was formed. The recent theory that coal is the product of marine vegetation, was shown to be inconsistent with the record shown in the coal beds of Ohio, particularly the lowest coal in the series. This coal lies in a series of narrow troughs or basins, which were evidently once marshes occupying local depressions, and the valleys of streams upon the then existing surface. Many of these deposits have been worked into and expose the following phenomena to view:

(1.) A fire-clay below each seam, penetrated in every direction with roots and rootlets of stigmaria.

(2.) A coal seam having a maximum thickness of six feet in the bottom of the basins, thinning out to feather edges.

(3.) The coal on the margins of the basins is sometimes thirty or forty feet above its place on the bottom.

(4.) An average of 2½ per cent. of ash.

(5.) A roof composed of argillaceous shale, of which the lower layers are crowded with impressions of plants.

Facts like these point wholly to the origin of coal in swamps and peat bogs.

Professor E. D. Cope, of Columbia College, described the fauna of a remarkable Eocene deposit in New Mexico, in which fifty-six species of animals were found, forty-five of them land mammals. It proves to be the most ancient Eocene fauna yet discovered. Professor T. Sterry Hunt, of Montreal, read a paper on the so-called Eruptive Serpentines; and Mr. Becker described some of the topographical results of geological faults and landslides.

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Cause of the Relation of the Coefficient of Adhesion to the Length of Belt in Contact with the Pulley.

BY WM. B. COOPER.

I submit the following as a simple explanation of a mechanical phenomenon the cause of which is not at first apparent. All the explanations in the text books are technical, and consequently not popular.

The law governing friction between surfaces is that it is directly related to the pressure with which they are brought together regardless of the *extent of surface in contact.*

If a belt is passed over a fixed pulley and attached to a weight, it is well known that the power necessary to raise the weight by drawing upon the other end will increase if the portion of the belt in contact with the pulley is increased, and to such a degree that if several turns are made around the pulley, the power required bears no comparison to the weight raised, so great has the friction become.

To explain this, let us imagine the portion in contact with the pulley to be divided into a number of sections; now, when sufficient power is applied to raise the weight, it is clear that, commencing at the weight end, the first section requires to move it a power equal to the weight, plus the friction between itself and the pulley; the second section will have a larger coefficient of friction on account of its being brought into closer contact with the pulley; this results from the fact that the resistance to be overcome is the weight, plus the resistance of the first section. Thus it is manifest that the last section has to overcome, the weight, plus the sum of all these increasing coefficients of all the other sections.

This explains the cause of the ability to transmit so much power by a belt coming in contact with only half of the periphery of a pulley.

This phenomenon is made possible by the convexity of one of the surfaces and the flexibility of the other. A number of shoes attached together would operate in the same way as the belt.

Where the surfaces are of such a character that the friction is at a maximum between certain pressures, it is clear that, where those pressures are exceeded, the width becomes an important factor, as it alters the pressure per inch between the surfaces; in other cases it is immaterial. The same would, of course, be true regarding the area of contact of inflexible surfaces.

SELF-REGISTERING SHIP'S COMPASS.

Among the exhibits at the recent Northeast Coast Exhibition which attracted a very large share of attention, perhaps none was of more universal interest than the self-registering ship's compass invented by Mr. Robert Pickwell, civil engineer, Hull, and which we now illustrate from diagrams and description given in the *Engineer*. This instrument has been subjected to a series of practical tests on passages between Hull and London, Hull and Newcastle, and Hull and Hamburg, with a view to ascertain its accuracy and usefulness, and in each case it has proved a remarkable success in keeping an accurate record of the working of the ship. So sensitive, indeed, is the apparatus that the act of heaving the lead twice and of stopping to take the pilot on board are distinctly shown on the diagram.

The engraving, Fig. 1, represents an elevation of a compass binnacle and stand, of the pattern used by the inventor, and Fig. 2 a cross section showing the inside compass and lamp, and the adaptation of the patent self-registering apparatus under the compass card. The wooden stand is lashed and screwed to the deck, which carries the ordinary bowl, covered by the binnacle top, with glass windows, the stand being of any convenient height. Inside the outer bowl the compass bowl is hung on gimbal rings in the usual way, and the compass card is seen below the glass cover or lid of the inner bowl, light being supplied at night by a top lamp, as shown in Fig. 2. The registering apparatus is fitted in the bowl below the card, and is indicated in Fig. 1 of the engraving. It consists of a barrel, Figs. 1 and 2, containing clockwork, which causes a second barrel within the first to continuously revolve at a given speed, the outer barrel being fixed and having two slots cut through on its upper surface parallel to the axis. The compass card has also a slot, shown by the dark line, curved in such a manner that some one part of it is always across one or other of the straight slots in the drum, and as the inner barrel is when in use covered with sensitized paper, it will be at once understood that in whatever course the ship is being steered a ray

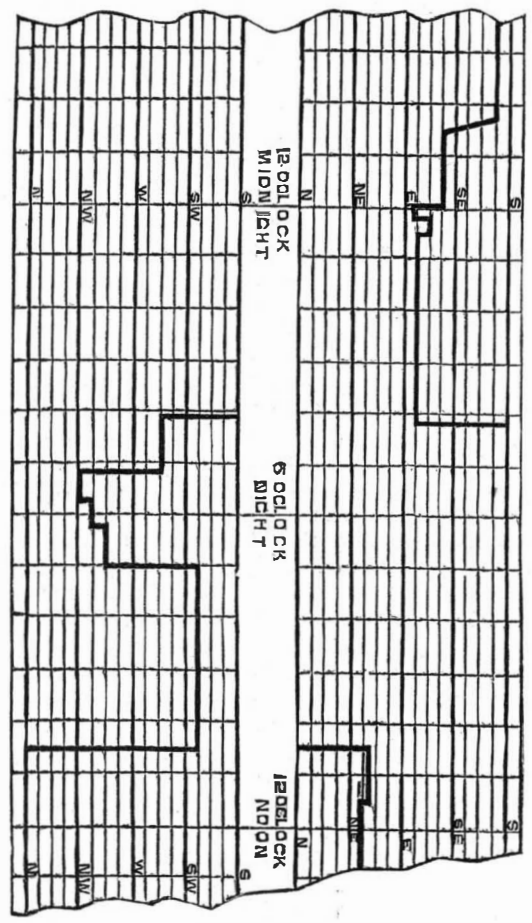

Fig. 3.—RECORD OF PICKWELL'S SELF-REGISTERING SHIP'S COMPASS.

of light either from the sun or from the lamp will pass through the small opening made at the intersection of the curved slot in the card with one or other of the straight slots in the drum envelope, and will produce a black mark upon the prepared paper, more or less distant from the center of the card, and which from its position will give an exact indication of the course of the vessel at the time. The revolving motion of the drum gives the duration of time the ship's head is on each course, as well as the time such courses are changed.

An actual diagram unwrapped from the barrel is shown in Fig. 3, vertical spaces representing directions, as indicated by the letters of the compass, and horizontal distances denoting time. To remove the paper the revolving barrel is drawn off like the drum of an ordinary Richard's indicator, through an opening in the side of the bowl, and all that is necessary to permanently fix the lines is to immerse the diagrams in a liquid solution for a short time. The papers are made for a day of twenty-four hours, or may be continuous so as to give the course for a period of three months, in which case it is proposed to inclose the apparatus in a locked case, which can only be opened by the owner of the vessel. The arrangement most in favor, however, is that for daily diagrams under the control of the captain, who can file them when fixed and produce them at the end of the voyage if required. He can also see the course made by his ship day by day in spite of thick weather, and without observation with the sextant, and can lay it down on his chart every twenty-four hours

The advantage of having an accurate record of the working of a vessel will be at once recognized by every shipowner, and as with Mr. Pickwell's invention this can be obtained without interfering with the free action of the needles, or without even altering the ordinary visible portion of the compass as at present in use, we shall hope soon to hear of its general adoption. The apparatus as at present supplied can be fitted to any ordinary compass, provided the bowl is not less than 10 inches diameter: but, if necessary, a smaller size could be made suitable for a bowl of 8 inches diameter. Mr. Pickwell received the highest award, viz., silver medal and special mention, at the Northeast Coast Exhibition.

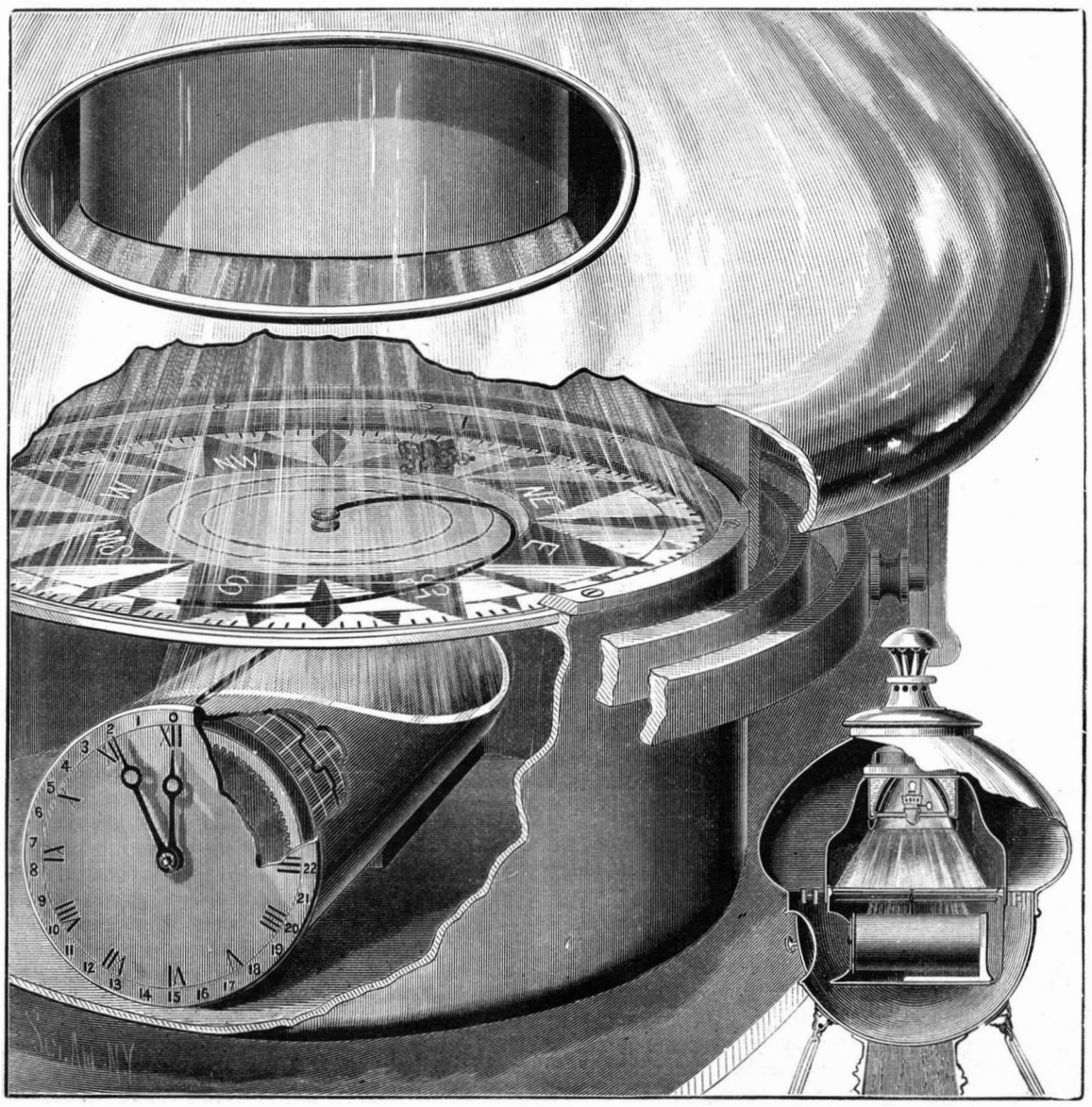

Fig. 1. PICKWELL'S SELF-REGISTERING SHIP'S COMPASS. Fig. 2.

Acid in Certain Kinds of Paper.

Papers sized with rosin size were found to have a more or less acid reaction due to free sulphuric acid, which has never been observed in samples sized with animal glue. The acid is probably derived from the alum or aluminum sulphate used in sizing, which is decomposed by contact with the vegetable fiber, as takes place in dyeing, a basic salt being deposited upon the fiber, and a portion of acid liberated.—*Prof. Feichtinger, in Chemiker Zeitung.*

Science in the Workshop.

The *Commercial Bulletin* truthfully says that when mechanics as a general body become more thoroughly impressed with the conviction that the way to advancement both as to personal position and monetary returns lies through the mastery of science in the application of principles to their daily work, we may anticipate some joint movement on their own part to establish means for acquiring technical knowledge. For instance, the laws of expansion and contraction, as applied to many castings, and even to the wrought iron and steel industries, would prevent much waste in the foundry and at the forge from the effect of unequal expansion and contraction, and also occasion fewer inequalities in the quality of that supposed treacherous material, steel. It would also prevent many mishaps to boilers, engines, and their accessories in cold weather.

A knowledge among workmen of the principles of inertia, as affecting bodies in motion, would frequently prevent a breakdown in starting or stopping machinery suddenly. For all connected with blast furnaces, the value of chemical knowledge is apparent, as enabling them to trace the cause of faulty results. There is scarcely a workshop of any importance in which an acquaintance with geometry will not be of value. In short, the value of science asserts itself every hour in the workshop. The scientific mechanic never falls into ruts either of thought or habit. Working more intelligently than others, he finds more pleasure in his labor; his suggestive faculties are ever at work, and he is ever alive to the possibility of mechanical improvements, from which he may reap a handsome reward. The manufacturers who have risen from the bench without acquaintance with technical science constantly feel themselves at a disadvantage. As all branches of science hold some relation to each other, the acquisition of any one portion of these will prove of value to the workman whatever his vocation.

THE author employs the following mixture for dyeing sole leather: 750 grammes Paris yellow, 150 grammes chrome yellow, 1250 grammes pipe clay, 1,000 grammes quercitron, 1,000 grammes alum, 750 grammes sulphuric acid, and 4 liters tragacanth solution. These are boiled together with 16 liters water, and the mixture, when cold, suitably applied.—*C. Larrabrec.*

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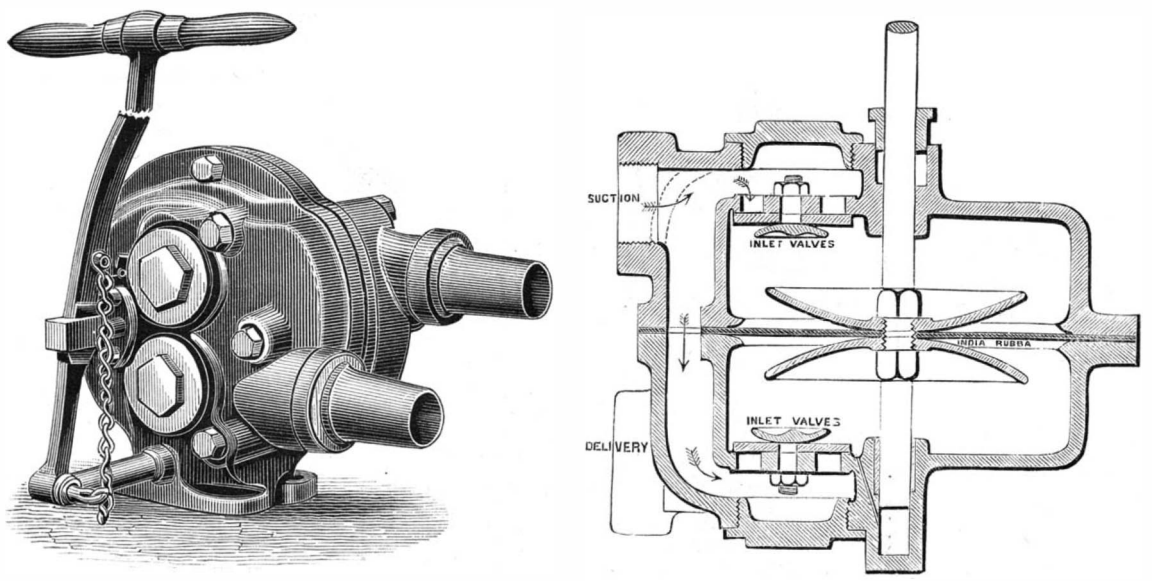
DIAPHRAGM PUMP.

This was one of the exhibits at the recent show at Tynemouth, Eng., relating to ships, boats, etc. The pump, says the *Engineer*, is suitable for short lifts, and is more particularly intended for ships, boats, fishing smacks, etc. It is simple in construction, and little liable to derangement. The pump is double acting, with separate suction and delivery valves on each side. In the center of pump is a sheet of soft flexible India-rubber, dividing it into two parts. On each side of this rubber are iron shields secured to a rod guided at both ends; one end of the rod is attached to a handle in the usual way. The suction and discharge of water is caused by alternately raising or depressing the India-rubber diaphragm. The general arrangement can be understood from the engraving.



IMPROVED DIAPHRAGM PUMP.

Sewer Gas Shampooing.

The London *Lancet* states that "recent and unsatisfactory experience in one or two West End hair cutting saloons" has led it to inquire whether sufficient care has been bestowed on the sanitary management of the shampooing contrivances. Those persons who avail themselves of the very refreshing pleasure of a "shampoo" must have noticed that they are compelled to bend over, and bring their faces in close proximity with the hole in the center of the huge basin used for this purpose. If they watch the soapsuds that form round this hole before any large volume of water is allowed to flow, they may perceive the air coming up the pipe; for it inflates the soap and forms a large bubble that bursts close under them. Whatever may be within, it is too near to avoid breathing its contents. Nor does the absence of any suspicious odor inspire a sense of security; for it is very evident that even a strong whiff of sewer gas would be lost in the scent that perfumes the soap and surrounding atmosphere. If, therefore, the pipes attached to the basins communicate direct with the house drains and the sewer, there is danger that the atmosphere breathed within a couple of inches of the aperture may carry, disguised under the fragrancy of the rose or jasmine, the virus of disease.

Shampooers on this side of the Atlantic may derive useful hints from the above.

An Electric Wagon.

The improvements in the storage of electric energy and in electro-motors have so far advanced, says *Knowledge*, that tricycles can be lighted and propelled by electricity, as was seen from the tricycle lately ridden by Professor Ayrton in London. The Faure accumulators in which the energy was stored for the lighting and driving were placed on the footboard of the tricycle, and the motion was produced by one of Professors Ayrton and Perry's newly patented electro-motors, placed under the seat of the rider. Using one of these specially made tricycle electro-motors and the newest type of the Faure accumulators, the total dead weight to be added to a tricycle to light and propel it electrically is only 1½ cwt., a little more than that of one additional person. In the tricycle ridden by Professor Ayrton the ordinary foot treadles were entirely absent, but with ordinary electric tricycles it may be desirable to leave the treadles, so that while electric propulsion alone is used on the level, the rider can, on going up a steep hill, supplement it by using the treadles, instead of, as at present with the ordinary non-electric tricycle, having to get out and ignominiously push his tricycle up the hill before him.

A New Dye.

The young growth of the poplar tree yields a dye which may be extracted as follows: The young twigs and branches are bruised and boiled for twenty minutes with a solution of alum, 10 pounds of wood requiring 1 pound of alum, in 3 gallons of water. The solution is filtered hot and allowed to cool, and, after standing some time, is again filtered from a resinous deposit. On exposure to air and light it develops a rich gold color, and may be used directly for dyeing orange and yellow shades upon all classes of goods.—*Deut. Farb. Zeitung.*

FIREPROOF STEAMERS.—The New Orleans *Times-Democrat* say that the steamer, Will S. Hays, now building, will have her upper deck made of corrugated iron, to protect the cabin passengers in case of fire. This is a movement in the right direction. We already have seven steamers with iron hulls. The final step is to make both hulls and upper works of the same boat, and all such boats, of incombustible materials.

The Four Forces in Nature.

BY GEORGE WHEWELL, F.I.C., F.C.S.

In a previous article we ventured to enunciate a theory to explain the fact that the same piece of carbon (or any other element) in different states of combination had in one case the power of motion, and was what is called living matter, and in the other case had not the power of motion, and was what is called dead.

In nature we recognized four forces, which we ventured to call atomic viva, organic viva, animal viva, and mensic viva (mind).

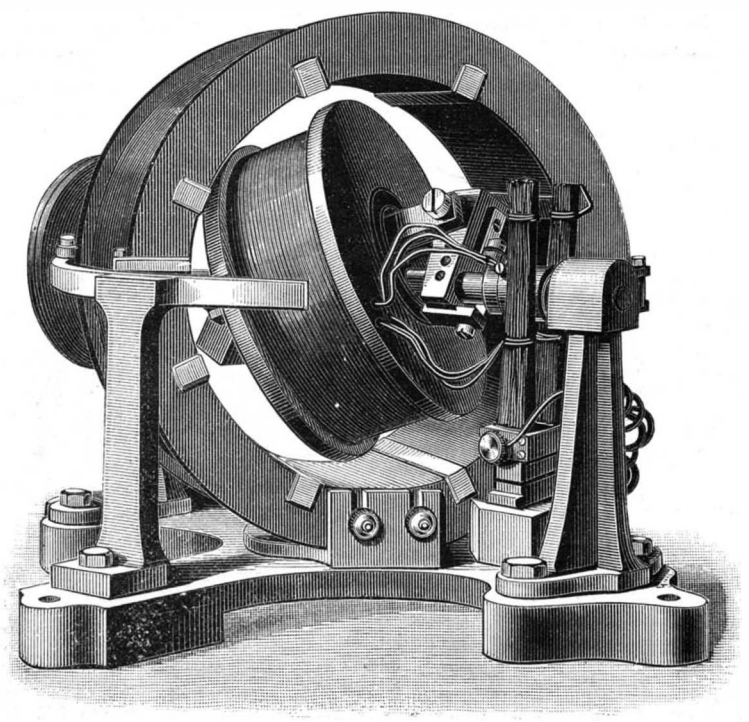
The same piece of carbon, in one condition having no power of motion, as when forming a portion of the root or stem of a plant, possesses atomic and organic viva. When it forms a portion of a nerve it possesses atomic, organic, and animal viva; and when it forms a portion of the brain, and causes man to think and act, it possesses all the four forces—atomic, organic, animal, and mensic (mind) viva.

We assume that the elements contain these four forces in a state of activity or otherwise, according to circumstances. When the element belongs to the mineral kingdom it possesses only atomic viva, the other three forces being latent. When it belongs to the animal kingdom the other three are either active or latent, according to circumstances—that is, according to the position they occupy in the body of a living animal or plant.

Take the life history of our theoretical molecule of carbon. Suppose that a molecule of carbonic acid gas floats about in the atmosphere, and is driven hither and thither at the caprice of every wind that blows. In this condition atomic viva is alone active, the other three being latent. In its passage over the earth it strikes against the leaves of an edible plant; the sun is shining, and the molecule of carbonic acid gas is absorbed by one of the leaves of the plant; the carbon is retained, and the oxygen is given off again. The carbon becomes a portion of the substance of the plant. It has changed its condition from being a portion of a poisonous gas to be nutriment for man or animals. From being a portion of dead matter it becomes a portion of living matter. The gardener takes the plant, cooks and eats it; by and by it is converted into blood, and is then in a condition to have its latent forces developed. It can become a portion of a muscle, and possess atomic, organic, and animal viva, and be a portion of a living body. It can become a portion of the brain, and produce thoughts—violent, demoniac, or sublime—at its own caprice. In this condition it possesses all the four forces in a state of activity. When it has produced these effects it again becomes carbonic acid gas, and finds its way into the outer world to be tossed hither and thither at the mercy of the winds.

This same molecule of carbonic acid gas may go through this endless change from century to century.

New forces must of necessity develop, and become latent in the molecule, in passing and repassing through this endless variety of changes.—*Journal of Science.*



JABLOCHKOFF'S NEW ELECTRIC MOTOR, THE "ECLIPTIC."

The Fees in the President's Case.

The public is at present being treated to a discussion about the fees of physicians and surgeons in connection with those handed in by the attendants on President Garfield. It is obvious, says the *Med. and Surg. Reporter*, from the amount of money placed at the disposal of the committee, that Congress did not contemplate paying claims of any such magnitude as have been put in. Probably the public also are of this way of thinking. The total amount of the fees claimed by the physicians is $85,000, or, including the relative claim, $110,000—considerably more than $1,000 a day. In spite of our desire to support the profession in its just rights, we acknowledge that this staggers us.

Improvement in the Paris Morgue.

The bodies in the Paris morgue are now frozen and kept in this condition until their final disposition. The freezing apparatus consists of a modification of the Carré method, in which the cold is produced by the evaporation of previously liquefied gaseous ammonia. But instead of water, a solution of calcium chloride, which remains liquid at a temperature of 20° F., is made the direct recipient of the cold thus generated, and is carried in pipes to the top of the building, whence it falls in cascades. The same fluid is again collected and re-exposed to the freezing machine. In this way the temperature of the room is kept well below the freezing point constantly. When bodies have become putrid or require to be kept longer than usual, they are placed in a row of cases like a set of pigeon holes, where, by means of the same apparatus, the temperature is maintained at a much lower point. The bodies which have been kept at 20° F., and which have been for weeks of stony hardness, show very little tendency to putrefaction.

JABLOCHKOFF'S NEW ELECTRIC MOTOR, THE "ECLIPTIC."

Electric motors evidently constitute one of the most enticing applications of electricity, and it is therefore not astonishing to find a goodly number of inventors always engaged with the question, notwithstanding the narrow field that limits the improvements and progress of which such apparatus are susceptible.

In effect, the Gramme and Siemens machines which are employed as electric motors convert into mechanical power as much as 80 per cent of the electric energy furnished them, and their performance may even reach, under certain special conditions, 90 *per cent.* There is, then, little progress to be expected as regards performance. Unfortunately, these machines are as yet relatively high priced, especially when they come to be constructed of small dimensions in order to make motors of them which develop a few kilogrammeters only, for actuating sewing machines, lathes, and in general, all machine tools for small industries. For such applications there is required a motor of simple construction and of as low a cost price as possible, since the saving in price is found to more than compensate for their inferiority as regards the work yielded. It was this line of thought that led to the invention, successively, of the motors of Marcel Deprez, Trouvé, and Griscom, all of which are derived from the Siemens bobbin, and constitute more or less happy modifications of the machine constructed in 1854 by the learned German physicist. In all these motors we find two essential parts: (1) a magnetic field obtained either by the aid of permanent magnets (as in the Deprez motor), or by the aid of electro-magnets (as in the Trouvé and Griscom apparatus); (2) a Siemens double-T bobbin traversed by the current furnished by the electric source, and which, by the aid of a shell commutator arranged on the axis of revolution, changes polarity twice per revolution. It is this reversal of the bobbin's polarities that produces its rotation. Experiments have demonstrated one fact that theory should have allowed to be foreseen, to wit, that it is necessary to give the parts submitted to changes of polarity as small a size as practicable so as to reduce magnetic inertia as much as possible; the effect of the latter being to dimin-

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ish the performance and velocity of the motor because of the retardation that it effects in the successive magnetizations and demagnetizations. It was Marcel Deprez, we believe, who was the first to enunciate this fact, and to thus explain the relatively feeble performance of the first motors constructed by Froment, Jacobi, Leroux, Larmenjeat, and others. It is this also that explains the relative power and effective performance of the Siemens bobbin motors, in which the magnetic mass in motion submitted to reversals of current is much smaller than in the first motors that we have just mentioned. And it explains, too, the good performance of the Gramme machines employed as motors, in which the changes of polarity are effected through successive sections.

A few inventors have gone a step further in this direction and *completely* done away with magnetic masses in that part of the motor submitted to reversals of current. The *Ecliptic* of Paul Jablochkoff, the inventor of the electric candle, belongs to this latter category, and the proem that the reader has just perused will permit us to give a description of the apparatus in a few lines.

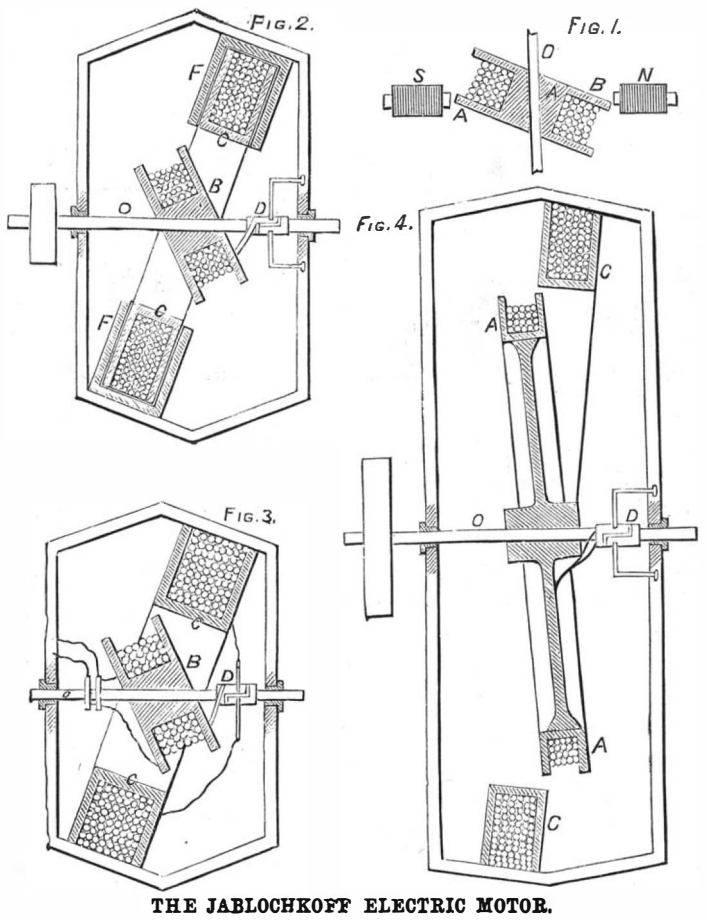
This motor consists essentially of two bobbins, one of them stationary and arranged in a vertical plane, and the other movable and fixed on a horizontal axis in an inclined position. It is to this latter position, which recalls that of the ecliptic to the equator, that Mr. Jablochkoff's apparatus owes its name. The stationary vertical bobbin is not in a vertical plane, perpendicular to the axis of rotation of the motor, but makes with such plane a certain angle that has been determined by experiment, and depends on the conditions of the apparatus's work.

The stationary bobbin is wound on a copper frame, and the movable one is fixed on an iron shell which, under the influence of the current traversing it, is converted into a short electro-magnet whose poles are formed of two circular disks. On the axis of rotation there is a commutator against which rub four brushes. This commutator is so formed that, during the rotation of the axle, the movable bobbin is traversed by a current *which never changes direction*, and preserves a permanent polarity in the flat electro-magnet; but at every half revolution the current is reversed in the fixed bobbin. The motor works, then, through the reciprocal attractions and repulsions of a movable permanent magnet, and of a fixed solenoid traversed by currents that are alternately of opposite direction. These reciprocal actions tend to produce a pivoting of the movable electro-magnet located in the interior of the fixed solenoid. The effect of the commutator's play is to cause a concurrence of these actions in the same direction, and thus to produce a continuous motion. Mr. Jablochkoff's motor is reversible, that is to say, it develops mechanical power at the expense of electricity and is capable of producing electricity at the expense of power.

We must remark here that, although the arrangement of this motor may appear to be new and original, the idea of preserving a fixed polarity in the movable part provided with an iron armature, and of reversing the current in the fixed part without iron, had already been applied by Mr. Bürgin, of Bale, to a motor which was exhibited at the Exhibition of Electricity in 1881, and which the inventor styled, because of its form, the *spherical motor*. As the experiments being made by the house Breguet with this motor are not finished, it is impossible to estimate its value from the standpoint of effective performance. But it appears to be simple in its construction; and its plainness, along with the low price at which it will be possible to offer it, constitute qualities sufficient to secure for it a goodly number of applications, provided its performance be, as is to be hoped, superior or at least equal to that of its predecessors.

Referring to the diagrams, Fig. 1 shows a simple form of machine, such as is described above. The bobbin, A, having cheeks, *a b*, of soft iron and wound with a coil of insulated wire, is fixed obliquely on the axis, O, and revolves between the poles of the electro-magnets, N and S. The obliquity of the coil is such that, in each revolution it presents the edges of *a* and *b* alternately to the poles of N and S, and alternating electric currents are set up in the coil of A. Fig. 2 shows a construction in which the coil, B, fixed obliquely on the axis, O, revolves within an oblique bobbin, C, which has an iron sheath, F, presenting interior polar edges toward the edges of B. The electric currents set up in the coil of B are collected and converted into currents of uniform direction by means of a commutator, D, of ordinary construction. In the construction shown in Fig. 3, the exterior bobbin, C, is of soft iron, constituting a solenoid.

The commutator, D, may be applied as shown, to alternate the currents in the coil of C, those in the coil of B being constant in direction, collected in the usual way, by rubbers bearing on rings, E. In this case, the internal bobbin, B, need not be of soft iron. When the machine is of large diameter, the interior coil, A, may be merely a ring of iron fixed on a wheel of non-magnetic material.—*E. Hospitalier, in Nature.*

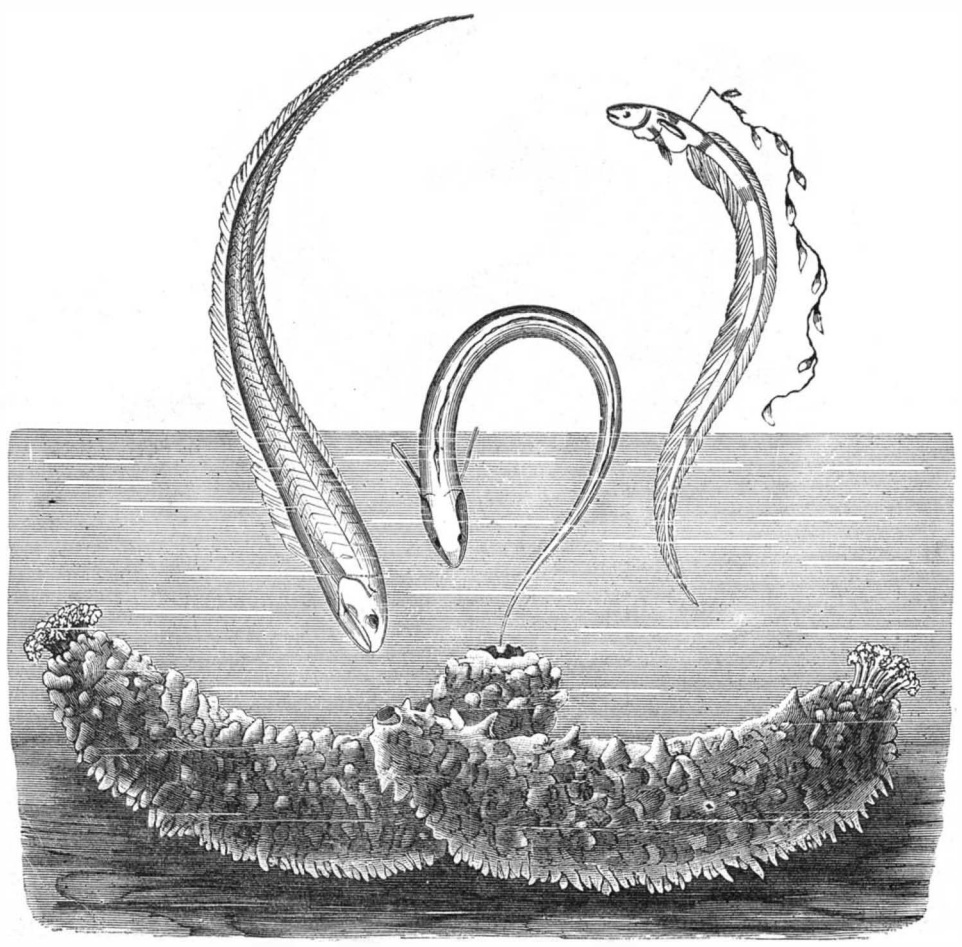


THE JABLOCHKOFF ELECTRIC MOTOR.

THE SEA CUCUMBER'S TENANT.

Among the curious phases of parasitic life which prying naturalists have discovered, the fish that lives in the stomach of the sea cucumber presents one of the most remarkable. Ordinarily the parasite is of a markedly lower type of organism than its unwilling host—the worm infests the vertebrate. In the case illustrated in the accompanying engraving, the host is greatly the inferior; the vertebrate finds its home within, if it does not also feed upon, the worm; and so far as trustworthy observation goes, the mature fish does not appear to long survive a separation from the holothurian.

The position in which the fish are shown in the engraving may, accordingly, be properly understood to be one suiting the artist's convenience only. The life history of this remarkable parasite is yet a mystery; it is probable that it enters the holothurian in early life and grows up with its host.



THE SEA CUCUMBER AND ITS TENANT.

The holothurian, thus strangely tenanted, is found on the coral reefs of Florida, in shallow water, and has received the specific name *Floridana*. It is a large species, dark brown in color, and with smaller tentacles than those of the species inhabiting our more northern coasts. It feeds upon pieces of corals and small shell fish.

An examination of the stomach of the parasitic fish, to which the name *fierasfer* has been given, would determine whether the fish shares the dinner of the host or dines upon him. The latter ingratitude is suspected, and the holothurian could probably endure it without material injury, as it is capable of ejecting its viscera entirely and speedily reproducing a new set of digestive apparatus; but the observed position of the fish, with its head to the holothurian's mouth, would rather indicate that it sought its food in materials selected and swallowed by the host. The *fierasfer* attains a length of eight inches; it is quite slender and of a silvery white color.

The *Leipziger Illustrirte Zeitung*, to which we owe our illustration, states that the young *fierasfer* carries on its back a sharp spine, to which is attached a long thread bearing a series of black and white flaps, thus mimicking a colony of jelly fish. In view of the stinging capacity of many jelly fish, it is suspected that the young *fierasfer* may secure a degree of exemption from the attacks of other fish by means of this delusive yet threatening flag.

Wire Cloth.

Wire cloth, such as is used by paper mills and for sieves, corn poppers, and hundreds of other purposes, is woven in the same manner as cotton or woolen goods, save that a large portion of the work is done on hand looms, samples of which can be seen in operation any day in factories on Cornhill, in this city, or near the Cottage Farm station on the Boston and Albany railroad. Wire cloth for window screens, requiring less care in its manufacture, is woven on power looms, and a single concern at Clinton, Mass., makes 15,000,000 square feet of this cloth per annum. The total amount of wire cloth woven by machinery for window screens alone in the United States is put down at 30,000,000 square feet per annum. For this purpose light and cheap iron wire is used.

For paper mills, cloth made of fine and strong brass wire is employed. There is no other process for making paper except by running the pulp over brass wire cloth, and this cloth has to be renewed every few months. A single firm of paper manufacturers in this city is put to an annual expenditure of $2,000 to replenish the wire cloth in its mills. As there are about 950 paper mills in the United States, it will be seen that the quantity of wire cloth required by them all is considerable.

Wire cloth, says the *Commercial Bulletin*, is sold by the square foot, and is graded according to the number of wires in an inch. Cloth which contains two meshes per linear inch or four per square inch, is designated as No. 2. That which contains 100 meshes per linear inch or 10,000 per square inch, is designated as No. 100. Cloth as fine as No. 120 is sometimes made, but it is always of brass or copper. No iron wire is used in any numbers above 40. The wire cloth used in window screens is No. 13, and that employed in flour sieves is principally No. 20. The brass cloth used by paper mills is mostly No. 60. The price of No. 2 iron wire cloth is 10 cents per square foot; that of No. 2 brass is 40 cents; and No. 2 copper is 45 cents. No. 100 brass cloth sells at $1.25 in small lots at retail, and at about $1.00 in large lots at wholesale. These prices will serve as fair examples of the value of wire cloth in general.

The Corn Starch Industry.

A conference of Western starch manufacturers was held in Cincinnati, in the latter part of October, to devise means for stopping a war of prices. Ten firms, claiming two-thirds of the manufacturing capacity of the country, agreed to consolidate their business to form a single joint stock company, and others were expected to join the combination. This action brings out the notable fact that two New York starch establishments, at Oswego and at Glen Cove, control the Eastern and foreign trade. They cannot compete for the Western trade with manufacturers in the West, owing to the double freight charges, the corn having to be brought from the West. The circumstance that the freight on corn is less than that on the starch made from it, however, together with the higher quality of the Eastern product, prevents the Western makers from controlling the entire trade.

RUSSIA estimates the value of the Siberian gold mines at $6,000,000 a year.

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RECENT INVENTIONS.

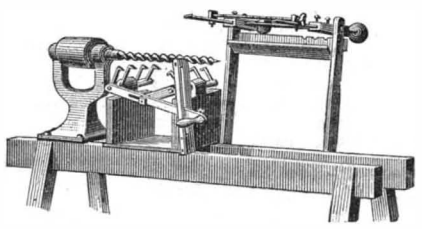
Improved T-Square.

This invention consists of the tongue or shaft of the T-square, made of an equilateral scale, and fitted in the head so that it can be readily taken out and shifted around on its longitudinal axis from side to side, in order that the different scales of the different sides may be set to the work, so that the draughtsman can set his points directly therefrom without the use of the dividers. The tongue of the square is made in the form of the common equilateral triangular scale, with any desired scales printed on it, and the head of the square has an equilateral mortise through it corresponding to the form of the tongue, and has brackets on the back, so that the tongue can be readily taken out and shifted around from side to side to present the different scales to the work on the paper for taking the measures directly from the scale. A binding screw fastens the tongue in the head, and a rabbet is made in the head to fit the edge of the board for keeping the tongue upright. The scales may be printed any desired length on the tongue.

This invention has recently been patented by Mr. Joseph W. Rowe, P. O. Box 2476, New Orleans, La.

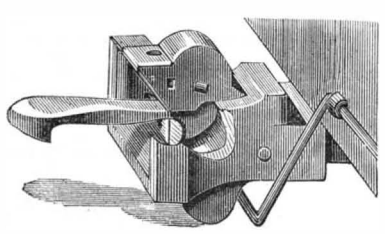
Hub Block Boring Machine.

The hubs of wagon and carriage wheels are commonly made of elm wood, and it is necessary that the central longitudinal aperture of the hub be on the pith line of the block to prevent cracking in seasoning. Mr. John S. Reid, of Muncie, Ind., has patented a device for boring hub-blocks directly on the pith line, which consists of a horizontal frame formed of two beams, upon the upper edge of which a track plate is fastened which overlaps the beam on the inner side. The track carries a sliding block holder provided with dogs, operated by a lever for pressing the dogs into the ends of the block, as shown in the engraving. The block is adjusted to its proper position by means of a swinging frame, provided at the ends with points which are forced into the pith in the ends of the block. When this adjusting frame holding the block is lowered, the pith line will be on a line with the longitudinal axis of the auger, and if the block is now seized by the block holder and the pith points are removed when the block is moved toward the auger, the hole is bored.



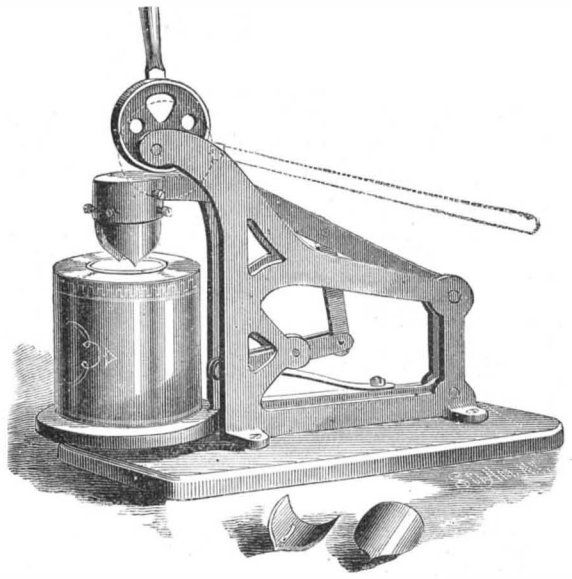
Improved Car Coupling.

A novel improvement in car couplings has been patented by Mr. Thomas McCabe, of St. Joseph, Mo. A drawhead is made with a central vertical slot in which is pivoted a weighted catch, as shown in the engraving. The catch is so pivoted that it tends to fall forward by gravity, and its forward movement is limited by lugs. Instead of using a link, a hook is employed that has its ends beveled on four sides, so that it shall be easily guided into the mouth of the drawhead. The hook is used with the nib down, so that as the end enters the drawhead it will fall over and engage with a crossbar, while the weight of the catch will prevent it from becoming disengaged. For operating the catch a lever is secured to a convenient part of the car and connected to a crank which may be pressed against the lower end of the catch. By means of notches in the guide, the lever may be locked out of contact with the catch, or the catch may be held in a raised position, locking the pin in one side of the drawhead.



IMPROVED CAN OPENER.

The engraving represents an improved can opener recently patented by Mr. William A. Stoddard, of Dallas, Or. The opener has two levers, which operate in conjunction in opening a can, one lever carrying the knives and having a downward motion, the other lever being provided with a platform, on which the can to be opened is supported. The upper lever is acted on by a cam lever, and the lower lever receives its motion from the upper one by links and an intermediate lever. A spring secured to the lower lever and pressing against the intermediate lever returns the parts to their normal position after use. The knives have curved edges, and enter the can top at two diametrically opposite points. The operation is as follows: The can to be opened is placed directly below the knives in an upright position on the plate on the lower lever. By depressing the cam lever the end carrying the knives will be forced downward, the can will be raised, and the knives will be forced into the head of the can and cut out the head. As soon as the cam lever is released the spring returns the parts. The knives can easily be removed in case they are to be sharpened. This can opener is very simple and at the same time capable of doing its work rapidly and well.



STODDARD'S CAN OPENER.

Destruction of Fish by Chloride of Lime.

Mr. A. Anthony Nesbit, who has conducted a long series of experiments in regard to the detention of chloride of lime in water, contributes an interesting paper to the *Chemical News*. The increasing disputes between owners of paper mills and those preserving fish have rendered it advisable that chemists should have a very delicate test for bleaching powder, which is the most deleterious pollution of streams by paper mills. Mr. Nesbit says: I have consequently conducted a long series of experiments, which have resulted in the following method, the delicacy of which is such that it enables us to detect from the two hundredth to the four hundredth part of that quantity of chloride of lime which is injurious to Prussian carp (*Cyprinus gibelio*).

The test used is a starch paste made in the following manner: 100 grs. of iodide of potassium are dissolved in 16 oz. of boiling water, and 100 grs. of starch, mixed with 1 oz. of cold water, are added gradually, and the whole boiled vigorously for thirty minutes (the long boiling being absolutely necessary for the production of the sensitiveness of the test).

This solution should be used as soon as possible after its preparation, as it rapidly decreases in delicacy, and the extraordinary fact must never be lost sight of that an excess of this test entirely destroys the reaction.

I test a water in the following manner, viz.: two No. 5 beakers of the same shape are filled with water under examination from the brook side and placed on a sheet of white paper, and 5 c. c. of the above solution are run from the burette into one of them; if no blue or violet color occurs at once the water is thrown away, the beaker is refilled, and 1 c. c. run in; if again no reaction, the beaker is again refilled and half a c. c. added, the beaker re-emptied, and so on, till only the tenth of a c. c. is used in the beaker—it being found that the smaller the quantity of chloride of lime present, the smaller the quantity of test required to exhibit it, and when we are dealing with small quantities of the chloride it has to be searched for with varying amounts of the test or it may escape notice.

By judiciously applying the above method I can detect the one two-hundredth of a grain of commercial bleaching powder in one gallon of water, or about one eight-hundredth of a grain of "available chlorine" in a gallon.

Now, from numerous experiments which I have conducted I find that it requires from one to two grains of commercial chloride of lime to inconvenience Prussian carp, consequently we can readily detect in so-called polluted water the one two-hundredth to the one four-hundredth part of the quantity which is injurious to these fish; and hardy as the Prussian carp are, I think it must be conceded that it would be unreasonable to consider that the common trout is two hundred times as delicate.

In future disputes, therefore, between the owners of paper mills and fish preservers there will be no difficulty in deciding whether or no the manufacturer habitually discharges an injurious quantity of chloride of lime into the stream.

I find, however, that chloride of lime in small quantities is rapidly reduced by the action of the organic matter in the water, which fact must not be lost sight of, and every hour's delay in testing it makes it more difficult to indicate pollution.—*Land and Water.*

Bleaching Textile Fibers.

This method is applicable to all textile fibers, either raw or manufactured. The following are the chief points: (*a*) use of bromine as oxidizing agent; (*b*) use of alkaline hypobromites; (*c*) the application of sulphuric acid, either pure or containing nitrous compounds, for the purpose of regenerating the bromine; (*d*) application of method *c* for the direct treatment of the mother liquors from saline waters, as a means of furnishing a convenient source of bromine. (*a*) The material to be bleached is put into a bath of hydrochloric acid (2 to 3 per cent), heated to 60° C., and allowed to remain there twenty-four hours. It is then transferred to a bath of bromine water (2 per cent) for another twenty-four hours, during which time it is kept thoroughly agitated. The material is then removed, the bath neutralized with a dilute solution of caustic soda, and the material returned for twelve hours. It is then transferred to another bath, where it is washed with a 10 per cent solution of soda, and finally with water. (*c*) Though the bromine has lost its oxidizing power it is by no means useless, as it can be recovered by the addition of sulphuric acid. The author states that by this method the bromine can be reused for a large number of times. The sulphate of soda that accumulates in the bath does not interfere with its efficiency for a long time. When that happens the bromine can be recovered as in *d* below. According to the author his method possesses the advantages of economy and the absence of the injurious effect on the fibers liable to the use of chlorine or hypochlorites. (*d*) Mother liquors containing bromine are decomposed with crude sulphuric acid. They are then shaken up with bisulphide of carbon, and the latter separated from the aqueous portion. The resulting solution of bromine in bisulphide of carbon is then agitated with a small quantity of water and fragments of lime, which by this means is converted into a mixture of bromide and hypobromite of calcium, the bisulphide being left in a fit state for further operations. The mixture of bromide and hypobromite of calcium can be decomposed with sulphuric acid and the resulting bromine water, filtered from the calcium sulphate, used again.—*Léon Jousselin, Mon. de la Teint.*

Fireproof Paint.

Various substances have often been proposed as fireproof coatings for the protection of woods employed for building purposes, but most of them have been abandoned as being either too costly or not sufficiently durable. The following process, invented by Messrs. Vildé and Schambeck, seems better fitted to succeed. We borrow a description of it from *La Papeterie.*

The paint consists of 20 parts of finely pulverized glass, 20 parts of finely pulverized porcelain, 20 parts of any sort of stone in powder, 10 parts of calcined lime, and 30 parts of water glass (silicate of soda), such as usually found in commerce.

The solid elements, having been powdered as finely as possible and sifted, are moistened and then intimately mixed with the water glass. This yields a mass of sirupy consistence that may be employed for painting, either alone or mixed with color.

The addition of the lime gives a certain unctuosity to the mass for whitewashing, and its combination with the silicic acid of the soluble glass serves to bind the other materials together. The proportions of the different elements above mentioned may be changed save that of the water glass, which must remain constant. These elements may even be replaced one by another; but it is always well to preserve the lime. Instead of the silicate of soda (soluble glass of soda) soluble glass of potash might be used, but the former is less expensive. The coating is applied with a brush, as other paints are, as uniformly as possible over the surface to be protected. The first coat hardens immediately, and a second one may be applied six hours or more afterward. Two coats are sufficient.

This paint may likewise be employed as a preservative against rust, and used as a coating for iron bridges, etc.

Relative Longevity in Various Occupations.

An interesting exhibit of the mortality in the different walks of life was furnished by the General Register in report on the death-rate of the whole population of England in 1851. From this it appears that out of every thousand persons between the ages of twenty-five and fifty-five, forty died on an average. Classified according to the most favorable mortality, and increasing downward, we have the following tables:

Below the Average.	*Above the Average.*
1. Merchants.	7. Miners.
2. Weavers.	8. Tailors.
3. Cobblers.	9. Bakers.
4. Carpenters.	10. Butchers.
5. Blacksmiths.	11. Liquor dealers.
6. Laborers.	

The mortality of the eleventh class is so great that in good companies they are only admitted with great caution, and on short endowment or term policies.

Mariners, also, are considered poor risks, as 35 per cent of the deaths among them are attributable to accidents. Among miners 25 per cent, among machinists 15 per cent, and among painters, well-diggers, and glaziers 10 per cent die in consequence of casualties. The callings of brewer, typesetter, tinsmith, lithographer, and stonecutter are also in a measure detrimental to a prolonged duration of life.

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ENGINEERING INVENTIONS.

Mr. David E. Grove, of Dallas, Texas, has invented a railway ditching machine for opening railway ditches and the removal of the dirt therefrom and loading it on flat cars. The machine is carried forward upon the track, and is provided with a steam engine for operating the ditching machinery and loading the dirt.

Mr. Samuel A. V. Hartwell, of Valley Center, Kan., has patented an improved car coupling having a lever pivoted in the interior of the drawbar, its inner arm being heaviest and resting upon the shoulder of a pivoted trip plate. To the trip plate is attached one end of a chain, the other end of which is attached to a crank on a crossrod pivoted to the drawbar. The ends of the cross rod have crank arms formed upon them, so that the link can be guided from the side of the cars to enter the bumper head of an approaching car.

MECHANICAL INVENTIONS.

Mr. John S. Griffin, of Cleveland, O., has patented a machine for making harrow teeth and other tools and implements by a drawing operation between rolls. It consists in revolving or rocking cams placed above and beneath the rollers and fitted for vertical movement to insure a true taper on both sides of the blank.

An improved rotary cutter for mortising machines has been patented by Mr. William A. Decker, of Huntington, W. Va. The bit is provided with a shank projecting at right angles and slotted to receive the fastening screw bolt, and has a lip upon its forward end whereby the bit is securely held and can be readily adjusted to cut a large or small mortise.

An improved grinding mill has been patented by Mr. George W. Wilson, of Lanesborough, Minn. The improvement relates to mills for cracking and flouring wheat and other grain, and it consists in the combination with the runner of rolls and drags inserted in radial recesses in the runner between the rolls and provided on their lower edges with inclined teeth.

A reliable and effective means of checking the descent of elevator cars in case of breakage of the suspension rope has been patented by Mr. John Johnston, of New York city. It consists in stop-mechanism operated by a safety rope, combined with the balance weight, so that when the suspension rope breaks the stop mechanism will be operated. By this means the inventor dispenses with extra weights and insures the operation of the stop devices.

An improved flour bolting machine has been patented by Mr. Ammi R. Smith, of Maroa, Ill. The invention consists in the combination of a separating reel, a return reel, and finishing reel, and suitable conveying devices connecting them, all arranged to first separate the bran, shorts, and coarse middlings from the flour and fine middlings, and then to spout the shorts and coarse middlings to the return reel, it being carried thence to the finishing reel.

Mr. Stephen O'Connell, of Billings, Montana Terr., has patented a wagon wrench formed of a rod having its upper part screw-threaded and provided with longitudinal grooves. On this rod one jaw plate is fixed and the other is loosely mounted to move up and down, it being guided in its movements by lugs passing into longitudinal grooves. A nut is loosely held in the movable jaw plate by a U-shaped frame or clip, so that by turning this nut the movable jaw will be moved to and from the upper end of the rod—that is, the jaws will be separated or brought together.

An improvement in brick machines has been patented by Mr. Milton Wright, of Fort Valley, Ga., which consists in the combination with the downwardly projecting end of a stirrer-shaft having a gear wheel attached to it, and the mould-carrying platform having two rack bars with adjacent teeth attached to its bottom, of a pair of gear wheels attached to the ends of a vibrating shaft, a sliding crossbar carrying the said shaft, and a lever pivoted to the crossbar, whereby the continuously-revolving stirrer-shaft can be made to move the mould-carrying platform in either direction.

Mr. Charles Whipple, of Leonardsburg, O., has patented an improved chain pump in which the buckets are suspended from crossbars carried by two endless chains. The chains are drawn around wheels in one direction or the other, and the buckets dip into the water and are then raised. When the rising buckets reach the top of a box or trough at the top of the well, the upper inner edges of the buckets rest against the curved ends of guide rods, and as the chains continuously raise the buckets, the buckets will be tilted and will pour their contents into the trough.

An improved hay or cotton press has been patented by Mr. Hiram Bankston, of Fort Smith, Ark. The invention consists in the employment of a right and left hand screw-threaded shaft or screw carrying nuts or crossbars, to which are applied levers fulcrumed upon articulated or pivoted bars or levers, constituting jointly powerful compound or toggle levers, which act upon a follower or plunger working in a chamber, to the upper edges of which are connected the hinged sides and ends of an extension of the said chamber. Above the aforesaid chamber is arranged a horizontally-sliding head block. A beater capable of operation by suitable means acts upon the contents of the press chamber to pack it previous to being compressed.

AGRICULTURAL INVENTIONS.

Messrs. Marquis D. L. Hartley and James M. Hartley, of San Diego, Cal., have patented a single tree foruse in horticultural operations—such as the cultivation of trees. It may be used without liability of injuring the trees, as is the case with the ordinary single tree.

A boiler or feed steamer that may be applied to an ordinary stove or furnace, has been patented by Mr. Jesse H. McCandless, of Oxford, Ia. This boiler, on account of its triangular shape, has a broad bottom and a large extent of heating surface, and will boil water more rapidly and with less fuel than an ordinary kettle.

MISCELLANEOUS INVENTIONS.

Mr. William Maynard, of New York city, has invented a filter, consisting of the combination, with a case or chamber, of a rigid porous filtering medium, a filtering medium composed of corundum in the form of a porous conglomerate, and having a hole through the same provided with an elastic stopper.

Mr. James R. Barry, of Brooklyn (Greenpoint P. O.), N. Y., has invented a new combined warbler and cage. The object of this invention is to connect with a cage an instrument for imitating the call or cry of a bird or animal confined in the cage, or for giving any other desired note or sound.

Mr. Frank De Forest, of De Soto, Mo., has patented a fish hook. The invention consists of two hooks pointed in opposite directions, with their points arranged to stand near each other, and are held against being spread apart by the action of the water by the bait. The shanks of the hooks are looped or bent into eyes around a pivot, and their upper ends have passed through them a loop formed on the end of the line.

A novel ferrule for fishing rods has been patented by Mr. Thomas H. Chubb, of Post Mills, Vt. The invention consists in securing ferrules in place by forming an annular groove in the ferrule after it has been arranged in place, indenting the ferrule in the bottom of the groove, and then milling the surface of the groove.

Mr. Francis A. Davis, of New York city, temporarily residing in Hightstown, N. J., has patented an automatic valve for opening and closing waste pipes in such a manner that all escape of sewer gas is prevented by positively acting mechanical devices, the invention being more especially applicable to all kinds of waste pipes leading from dwelling houses.

An improvement in tuyeres has been patented by Mr. August Werner, of Leadville, Col. The object of this invention is to prevent injury to the blast pipe and blower from the backward pressure of gases in the furnace; the invention consists in forming a flexible joint between the nozzle of the tuyere and the blast pipe in such manner that provision shall be made for the escape of gases at the base of the nozzle.

A novel hame fastener has been patented by Mr. John J. Curry, of Plains, Pa. The invention of a bar provided with one or more ratchet teeth, and a bar provided with a pivoted lever engaging with the ratchet teeth and operating as a cam, each of the bars being provided at its outer end with a hook for engagement with the loop or eye of the hame and a bolt for preventing displacement.

A convenient and portable apparatus for roasting coffee, popping corn, or heating or cooking other substances, has been patented by Mr. Hugh P. Buffon, of Fort D. A. Russell, Wyoming Ter. The roaster consists of a long and a short cylinder, the latter sliding within the former, and provided with heads having central journals, the one serving both as a pivot and a handle for the head.

A novel combined coal hod and sieve, patented by Mr. Alexander Watson, of East Pepperell, Mass., will sift ashes and separate them from the cinders without permitting the dust to spread, and without emptying the ashes into a separate vessel or receptacle. The invention is an improvement on the combined coal hod and sieve for which Letters Patent No. 243,018 were issued to the same inventor on the 14th day of June, 1881.

An automatic cut-off for boneblack kilns has been patented by Messrs. Cyrus T. Rayner and Richard Stenhouse, of New Orleans, La. By means of this invention the cut-off of boneblack kilns used in sugar houses is operated by mechanism requiring but little power. The invention consists in a regulating plate and a cut-off roller operated by an endless chain for drawing the coolers at intervals, as required.

An improved spring bed bottom has been patented by Mr. Upton Miller, of Mount Morris, Ill. The invention consists in the combination, with the springs of a bed bottom, of links attached to these springs, and to spiral rings between these springs, and in chains connecting the springs of the pivoted head rest with the springs of the fixed part of the bed bottom.

A machine by which cotton or woolen yarn, silk, worsted, or other vegetable or animal fiber may be bleached, scoured, steamed, dyed, or dried in the cop or on the bobbin, has been patented by Mr. William Maybury, of Garnerville, N. Y. This obviates the necessity of reeling the yarn for these operations, as is now the practice, and saves the labor and waste of dyeing and bleaching the yarn in the skein.

A convenient and ornamental cabinet for containing needles in papers for the use of retail shopkeepers has been patented by Mr. Thomas Harper, of Redditch, County of Worcester, England. A cabinet is provided with receptacles for containing the packages, and fitted with slides whereby the packages can be readily withdrawn one at a time.

An improved draught equalizer has been patented by Mr. Philester G. Rowlee, of Hamilton, Mich. It is employed to work three horses abreast on a tongue or pole where two horses are used on one side of the tongue and one horse on the other side of the tongue, and by means of the device employed the draught will be equalized upon the three horses without perceptible side draught and upon the ordinary length of wagon tongue.

An improvement in gun barrels has been patented by Mr. Robert L. Stevens, of Albany, Oregon. This invention relates specially to shot guns for sportsmen's use, the object being to furnish a gun that can be readily changed for use at long or short range, as required, so that with one gun the user may obtain the same results as with two. The invention consists in a hinged choke muzzle combined with the main barrel, and fitted for instantaneous movement by connections operated at the stock.

An improvement in bee hives has been patented by Mr. Martin Van Ensley, of McMinnville, Oregon. This hive is made so that when honey is to be removed from the front surplus honey chamber slides are adjusted to close the holes through the honey board. With this arrangement bees cannot enter the comb frames from the brood chamber, and the bees in the frames will pass out through the passages in the bottom of the hive, so that the honey can be removed without disturbing the bees.

Mr. Willis B. Marvin, of New York city, has recently patented an improvement in fireproof safes consisting of a frame fitting over the edges of the walls and having a slot in it, through which the back plate may be inserted, the plate being afterward fastened to the frame by means of screws and rivets, rendering the safe stronger and more secure. The invention also includes improvements in the safe door, which improve its fireproof qualities.

Mr. John J. Thomas, of Salt Lake city, Utah Ter., has patented a tongue support by which the horses may be relieved of the weight of the tongue of the wagon. It consists of a short lever located vertically in front of the axle and sand board, with a strong spring behind the lower end, the upper end having a rod or bar connected to it, and extending along over and beyond the evener, where a locking device is provided for readily connecting it with the tongue when it is wanted to support it.

An improvement in barbed wire fences has been patented by Mr. Frank M. Harris, of St. Charles, Mo. The object of this invention is to cheapen the construction of barbed wire fence by dispensing with a portion of the posts ordinarily used. The posts are placed a considerable distance apart—say one hundred feet—and a suspension system consisting of a catenary wire supported by the posts to which the horizontal wires are all attached at regular intervals by vertical wires or strips, is substituted for intermediate posts.

An improved eaves trough hanger has been patented by Mr. Joshua Draper, Jr., of Oxford, Ala. This eaves trough hanger is composed of a clasp with a hook on each side adapted to be bent over the edges of the trough, and a flat tapering spike made in one piece with the lower part of the clasp, and in the same horizontal plane therewith, to afford a broad bearing for the trough, the spike being provided with a shoulder or by head, by means of which it may be driven into the wall of a building.

Mr. Charles L. Bates, of New York city, has invented a bell pull, which consists in a bell lever constructed with a base plate having an opening and provided with a segmental ring flange upon its outer side and upon its inner side a bridge carrying a lever pivot having a cap plate screwed upon its outer end. Upon the pivot is placed a hub having a rigid arm and provided with holes to receive a pin attached to the handle arm, so that the said arms can be adjusted in different relative positions.

Mr. Charles A Schnell, of Troy, O., has patented a fire escape which consists of a hook combined with a pole formed of a series of sections provided with socket rings at the upper ends and with shoulders and catches at the lower ends; the hook carrying a guide rope, upon which a car is moved by means of a cord passing through a pulley on the hook. The hook is engaged with a window sill by means of the pole, the latter then being detached. The car is worked by means of a windlass to the wagon upon which the escape is moved about.

An improved chair which can conveniently be converted into a desk has been patented by Mr. Vestal W. Woodward, of Indianapolis, Ind. The chair has a revolving seat, arm rests, and a movable back containing pigeon holes, and provided with a pivoted leaf covering the pigeon holes. The back is also provided with racks fitting in grooves in the side braces of the chair, and engaging with cog wheels on a transverse shaft provided with a crank. When the chair is to be converted into a desk, the back is moved from the chair by turning the crank, and the pivoted leaf is lowered to rest on the arm rests.

A novel rein holder has been patented by Messrs. C. M. Howell and C. W. Burdick, of Lansing, Mich. This invention consists of a clip spring differing in form according to the form of the dash board to which it is to be attached, but adapted to attach to the dash board by clipping on to the top, the spring having a bar of suitable form attached to it so as to be supported a little above the top of the dash board, and extending each way along the dash board a suitable distance from the attaching spring. To this bar other springs are attached and supported over and along the top of the dash board, so as to pinch and hold the reins between them and the dash board when the reins are slipped under the springs.

Mr. Gill W. Metcalfe, of Baltimore, Md., has invented an automatic cut-off for gas burners, to be attached to gas burners for automatically turning off the gas, if from any accidental cause the gas should be blown out or the flow stopped. It is an improvement upon the form of device for accomplishing the result in which a bent bar is arranged in close proximity to the gas flame, and is held when expanded by the heat in a position where it strikes an arm on the gas cock, and holds the latter open against the tension of a spring or weight, and which bent bar, when it cools and contracts from the extinguishment of the flame, passes to a position where it releases the gas cock and allows the latter to close from the action of the weight or spring.

An improved desk, which can be adjusted in height and inclination, and on which a person can write very conveniently without bending forward, has been patented by Mr. Samuel A. Cummings, of Madison, Wis. The desk has a swinging or pivoted writing board provided at its upper edge with a bolt adapted to be passed into one of a series of apertures in a curved bar attached to an arm projecting from a box resting on the plate to which the writing board is pivoted This plate is mounted vertically adjustable on a standard secured to a flat base. The lower edge of the writing board can be brought very close to the body, and the legs and knees of the writer can be passed under the writing board, so that the person need not bend forward while reading or writing.

[OFFICIAL.]

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FOR WHICH

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November 7, 1882,

AND EACH BEARING THAT DATE.

[Those marked (r) are reissued patents.]

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Notes & Queries

HINTS TO CORRESPONDENTS.

No attention will be paid to communications unless accompanied with the full name and address of the writer.

Names and addresses of correspondents will not be given to inquirers.

We renew our request that correspondents, in referring to former answers or articles, will be kind enough to name the date of the paper and the page, or the number of the question.

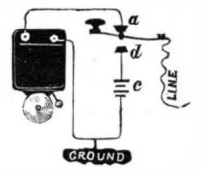
Correspondents whose inquiries do not appear after a reasonable time should repeat them. If not then published, they may conclude that, for good reasons, the Editor declines them.

Persons desiring special information which is purely of a personal character, and not of general interest, should remit from $1 to $5, according to the subject, as we cannot be expected to spend time and labor to obtain such information without remuneration.

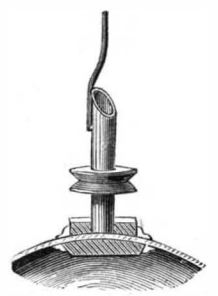
Any numbers of the SCIENTIFIC AMERICAN SUPPLEMENT referred to in these columns may be had at this office. Price 10 cents each.

Correspondents sending samples of minerals, etc., for examination, should be careful to distinctly mark or label their specimens so as to avoid error in their identification.

(1) W. P. S. asks how to arrange two electric call bells on one wire, half mile apart, with open circuit batteries, so that they will work. How many cells of Law battery will I require? A. The annexed engraving shows the arrangement of bell battery and key at one end of the line. Both ends are arranged in the same way. The fixed end of the key is connected with the line, and the back of the key rests normally against the top contact, *a*, which communicates with the ground through the bell magnet. The bottom contact, *d*, of the key is connected with one pole of a two cell battery, *c*, the other pole of the battery being grounded. When an electrical impulse is sent from the distant station, it passes through the key, the top contact, *a*, and the bell magnet, to the ground. When it is desired to call the distant station, the key is pressed down and the current passes from the battery, *c*, through the contact, *d*, and key to the line, ringing the bell at the distant station.



(2) A. P. asks: How can I bore a quarter inch hole in the top of a glass globe most easily, with least danger of cracking? The globe is one such as is used to cover statuary, etc. A. To drill a quarter inch hole in your glass shade make a hole in a piece of wood or metal of the size that you desire to drill in the glass. Fasten it with beeswax upon the glass for a guide. A piece of brass or copper tubing, quite thin, is supplied with emery (No. 100) and water, and twirled between fingers, or with a bow string, this will cut a hole in a few minutes. You can feed the emery and water a little at a time through the tube. The sketch will give you an idea as to the principle.



(3) J. B. V. writes: You will grant a favor to a reader of your valuable paper by telling me how to polish a mosaic (Florentine) table which is a little discolored by dampness and effects of handling. The stone is black slate, with flowers, etc. A. Use oxide of tin or putty powder wet with water, enough to make it a thin paste. Rub the table with a cloth cushion with considerable pressure, using the putty paste rather freely; add a little water to keep the surface wet. When the desired polish is obtained, which you will see by wiping clean in spots, wash the table with clean water, and wipe with a soft linen cloth.

(4) D. H. L. inquires as to the process of painting on glass, in imitation of gold and silver leaf, the same as is used on druggists' and business signs? A. Yellow ocher mixed in oil is sometimes used, but gold leaf or paint is much superior. Gold or silver leaf is applied to a very thin solution of gelatine brushed over the glass. The portion of leaf forming the letter is backed up with paint. The surplus leaf is washed off when this paint is dry.

(5) S. B. asks: What is the best cement for mending broken minerals, fossils, pottery, arrowheads, etc.? A. Starch, one quarter ounce; white sugar, one ounce; gum arabic, one-quarter ounce. Dissolve the gum in a little hot water, add the sugar and starch, and boil until the starch is cooked.

(6) J. M. G. writes: If a vessel is filled with saturated steam and closed tight, and a fire put under, will the superheating increase the pressure per square inch? A. Yes; about one-four-hundred-and eightieth part for each degree the temperature is increased.

(7) W. W. writes: 1. I have made me a rocking valve engine, single-acting, of 3 inch bore and 8 inch stroke, with a balance wheel weighing 10 pounds, being 10 inches in diameter; but I think that is too small a balance wheel. A. Your fly wheel should be three times as large as it is. 2. I would like to know what horse power I can obtain from it at about thirty-five pounds of steam as it is, and with a proper balance wheel, of which I would like to have you give me the dimensions and weight. Please give me the rule to find the horse power of single-acting engines? A. Calculate the power of your engine as an ordinary double-acting engine by the rule in SUPPLEMENT, 253, and take one-half the result for a single acting engine. 3. How many square feet of heating surface would it require for a tubular boiler to run such a steam engine as I have described? A. The quantity of heating surface will depend upon the velocity of your engine. 4. My engine has but one cylinder: would it be strong enough to run the dynamo electric machine described in SUPPLEMENT, 161? A. With sufficient steam supply, yes. 5. Does such an electric machine give electricity of intensity or quantity? A. It depends on the winding of the armature. Coarse wire gives quantity, and fine wire intensity. 6. How much is a volt in electricity? A. A volt is substantially equivalent to one cell of Daniell battery. 7. Would putting a little oil on the rubbing surfaces of the springs of an electric engine do any hurt? A. Yes. Oil is an insulator and would have to be pressed from beneath the springs to get the current through.

(8) A. E. 19 inquires: Will you inform me what is used by the American ladies to bleach a brown hair to a light golden color? A. Peroxide of hydrogen as recommended in SUPPLEMENT, No. 349, is now used with success.

(9) K. E. H. asks: What is the most rapid way of making a barrel of sirup of wild cherry without heat? A. Take five troy ounces of the bark in coarse powder and thoroughly moisten it with water; allow it thus to stand for twenty-four hours, and then pack it tightly in a percolator and add more water until a quart has passed; to this add twenty-eight ounces of sugar, and dissolve it by agitation. This process affords a fine sirup with all the virtues of the bark unimpaired by the injurious action of heat.

(10) J. H. asks: What is the fastest time on record from New York to Queenstown, and by what vessel was it made? A. Steamer Alaska—6 days 22 hours.

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(11) J. F. S. writes: Please give me a good receipt for preventing the hair of the head from falling out? Try the following, which has been successfully used: Aromatic spirits of ammonia, two ounces; glycerine and rose water each, two ounces; tincture of cantharides, one-half ounce; alcohol, sufficient to clarify the mixture.

(12) T. N. writes: A friend has a common flat boat, 16 feet wide, 75 feet long. He wants to run it by steam, with side wheels. Will two common slide valve engine, 7½ inch bore by 3 feet stroke direct to shaft, turn wheels 12 feet in diameter, 9 inch x 3½ feet bucket, and run the boat 7 miles an hour? A. Yes; but we think your wheel should not be over 10½ or 11 feet diameter.

(13) W. D. K. writes: I have a cistern which does not hold water. Upon letting it get dry it is evident that the leak is not in any one place, but is general by percolation throughout the walls and sides. Will cement remedy this, and if so, which kind is best, and in what proportions of materials? If not by cement, how can the trouble be remedied? A. We would advise cementing it over with a cement made by mixing silicate of soda solution to a paste with quicklime.

(14) D. G. P. asks what is the best form of condenser for a steam launch, 30 feet long? What should it be made of—copper or brass? A. The cheapest and lightest form is a keel condenser, that is, a copper pipe outside the boat, fitted alongside of the keel, and running aft from the engine to the stern post, and then returned on the opposite side and the end connected to the air pump.

(15) R. asks: Which will be most economical of fuel in driving a 20 ft. catamaran—a screw or paddle wheel; in either case to be placed between the boat, and of course free from dead water? Have plenty of depth of water for screw. A. We are of the opinion that a screw will give the best results, as the weight of the machinery will be less, consequently the boat draws less water than with paddle wheel. 2. What is the best method of feeding a small boiler, *i. e.*, what will be the surest and require least attention? A. There is no mode of feeding that is reliable without attention. It is usual to have two independent means, say a feed pump and an injector.

(16) L. F. writes: In your issue of May 27, 1882, p. 332, the Massachusetts Railroad Commissioners recommend the drilling of the stay-bolts in locomotive boilers, ¾ in deep, $\frac{3}{16}$ in. diameter. Please inform me what is the return or benefit. A. These braces almost invariably break or crack at the edge of the plate, and by so drilling the braces a break is discovered at once by the leak through the hole drilled in the brace. 2. Why is it in making silver solder we use or combine the two metals, silver and brass, in certain proportions, so the solder will melt at a lower temperature than the article we are soldering? How does the combining the two metals lower the melting point of the composition? A. It has never been satisfactorily explained.

(17) D. & H. S. write: We are using a large quantity of borax for welding cast steel to iron, and we believe that you can tell us the best way to prepare it for application. We now pulverize it by attrition, or perhaps you may say by grinding, and then apply it to the heated metal with a small ladle or spoon, and by this method much of it flows off into the fire, and, as we think, is a waste. Can you tell us of any better method? If you can so tell us, we shall be glad to pay you for it. A. Powder your borax in the manner you describe, and heat it in an iron pot gently until it ceases to boil, and then to fusion. Pour it out on a flag stone, and when cool break into pieces and use. In this manner less need be used. It will not boil upon the metal, and consequently less loss will be incurred.

(18) W. R. asks what makes the rumbling noise in what they call the whistling buoy at Sandy Hook. A. The "whistling buoy," off Sandy Hook, is a heavy shell of iron which takes in air when it is raised by the waves, and when it falls forces the air through a pipe ending with a whistle like a steam whistle. The note of the whistle is very "low."

(19) D. F. writes: I would like to have you decide a point in dispute. I have a tubular boiler which I use for thrashing from June to October, after which it is laid up. I used to clean it out well, and fill up with clean water, and let it stand so when not in use. Last winter a boiler maker told me to fill the boiler to the dome with water, then put in 5 gallons of black oil, fire up until I had 20 pounds steam, then blow off slowly. This, he said, left the oil covering the inside of boiler and all the flues, prevented rusting, and took off any scale remaining in boiler. Which is the best plan to adopt? A. Cleaning out and refilling your boiler was proper as far as it went, but if you did not boil the water it still contained air, which is a source of trouble. If you get up steam with the boiler full and blow a little steam from the safety valve, all the air will blow out, then shut every outlet tight. You will find your boiler in the best condition for work at the beginning of the season, and free from rust inside. This is the universal practice with boilers used for house heating in this climate, where there are thousands in use that are steamed only about six or seven months in the year. We do not know that there is any scale-removing virtue in the oil. Tannic acid or a weak decoction of oak or hemlock bark is much used for removing scale where hard water is used.

NEW BOOKS AND PUBLICATIONS.

DIE MAGNET ELEKTRISCHEN UND DYNAMO-ELEKTRISCHEN MASCHINEN UND DIE SEGENANNTEN SECUNDAR BATTERIEN. (Magneto Electric and Dynamo Electric Machines and Secondary Batteries.) By Gustav Glaser De Cew. Wien, Pest, Leipzig: A. Hartleben. 1883. pp. 264.

This is the first volume of an electro technical library, by Mr. Glaser De Cew. The author gives a clear description of the continuous and alternating current dynamo electric machines, and a history of the development of these mechanisms; the physical laws governing the construction of the machines, the merits and demerits of the several kinds. Secondary batteries are discussed in separate chapters. The use of electricity for lighting and other purposes also receives proper attention. In an appendix the author gives various formulæ for the construction of electro-magnets and instruments for measuring electrical currents. The work is handsomely printed and is well illustrated.

KATE SANBORN'S SUNSHINE CALENDAR FOR 1883. Consists of a pictorial card on which the daily calendar for the year is mounted. Appropriate poesy for each day. James R. Osgood & Co., publishers, Boston. C. T. Dillingham, agent, 678 Broadway, New York.

NAUTISCH-TECHNISCHES WOERTERBUCH DER MARINE. Bearbeiter von P. E. Dabovich. Pola, 1882.

The peculiarity of this new technical dictionary consists in its polyglot character, four languages being represented, viz., German, Italian, French, and English. It appears in parts of eighty pages each. The twelfth part brings it to SCH of the first volume, in which German and Italian terms (mixed) lead, while the German words are followed by Italian ones, or Italian by German, and both of these by French, and that by English. The different languages are distinguished by the type, Italian and English being in *italics* of different fonts, French in spaced Roman letters, and the German in plain Roman.

GIORNALE DI ARLIGLIERIA E GENIO. Roma: 1882.

We have received part second for May, 1882, of this handsomely illustrated journal. A considerable portion of the plates as well as the letter press is devoted to the application of the electric light to military purposes. This is followed by an illustrated article on the effects of dynamite, and other matters of interest to military men.

JOURNAL D'HYGIENE is a weekly paper published by Dr. Prosper de Pietra Santa, at 54 Ave. de Wagram, Paris, at 20 francs, foreign 22 francs. Each number contains 16 pages about half the size of these, filled with interesting and useful reading connected with this important subject.

ILLUSTRIRTES HAND UND HULFSBUCH FUER DEN PRAKTISCHEN METALLARBEITER. Von H. Schuberth. Hartleben, Vienna, Pest, Leipzig: 1882. Illustrated Handbook and Practical Metal Workers' Assistant.

This practical and exhaustive work is intended to cover the entire domain of technical metal working, while the sciences that bear upon the subject are also briefly explained so far as they interest the artisan. The work is issued in parts of forty-eight pages each, ten of which have already been received, and five more are to follow, so that the complete work will consist of seven hundred and twenty pages, illustrated with three hundred wood cuts and fifteen colored plates. Price in Germany, 15 cents per part; $2.25 for the entire work. The book is divided into six sections, the first being devoted to the metals, their occurrence and preparation, their chemical properties and qualitative tests. The second relates to making moulds and castings, also the galvano-plastic art; the third treats of working metals, such as rolling, drawing, spinning, bending, cutting, welding, soldering, riveting, etc. The fourth describes the decoration of metals, etching, polishing, enameling, varnishing, etc.; in the fifth we are to have a description of the motors, including the steam engine, hot air, gas, and water motors, while the final chapter will treat of geometry, mechanics, and drawing.

HAND BOOK OF TENNESSEE. Prepared by A. W. Hawkins, State Commissioner of Agriculture, Statistics, Mines, and Immigrations; assisted by Henry E. Colton, Geologist and Mining Engineer. Nashville, Tenn. 1882.

Describes briefly the geography, topography, and geology of Tennessee, its useful minerals and their outcroppings; its timber, agricultural products and capabilities; railways, educational, social, and political institutions; the natural and civil divisions of the State and their several characteristics; and gives much other information of interest to intending settlers and investors in mines and other properties within the State.

POINT LACE AND DIAMONDS. By George A. Baker, Jr. New York: R. Worthington.

A new edition of Mr. Baker's pretty little book of society verses, with some additions. Mr. Baker is clever at verse making—so clever that it seems a pity that he should spend his time over such trifles.

HOW TO BE WEATHERWISE. A New View of our Weather System. By Isaac P. Noyes. New York: Fowler & Wells. 25 cents.

Explains briefly the conditions and effects of high and low barometer and other meteorological phenomena upon the interpretation of which our Signal Service weather indications are founded; and shows how by a proper study of the weather maps everybody may become usefully weatherwise.

HOW TO KEEP A STORE. By Samuel H. Terry. New York: Fowler & Wells. 12mo, pp. 406. $1.50.

The author seeks to give to young men beginning or contemplating a venture in retail trading the benefit of 30 years' experience in merchandising. The author's spirit and method are commendable, and the advice he gives will be found suggestive and worthy of thoughtful consideration by all young merchants and merchant's clerks. It is a good book to have around a store and in mercantile libraries for the instruction of beginners and the entertainment of the more experienced.

THE MODERN HOUSE CARPENTER'S COMPANION AND BUILDER'S GUIDE. By W. A. Sylvester. Boston: A. Williams & Co. $1.25.

An unpretending handbook which has grown out of the author's experience and needs as a practical carpenter. The information is well selected, well put, abundant for so small a book, and, so far as necessary, clearly illustrated by diagrams.

Business and Personal.

The Charge for Insertion under this head is One Dollar a line for each insertion; about eight words to a line. Advertisements must be received at publication office as early as Thursday morning to appear in next issue.

Lettering for Draughtsmen.—1 sheet, 25 cts.; 5 for $1; 50 for $8.50. One-third discount to trade. W. A. Lorenz, Hartford, Conn.

Wanted—Four miles second-hand T-rail for tramway. Weight about 30 pounds to yard. G. Gunby Jordan, Columbus, Ga.

Foot Lathes. W. E. Lewis, Cleveland, O.

Want nice model, in proportion, of 8 wheel car, with metal wheels, axles, etc. G. B. Thompson, Pittson, Pa.

Emery Grinding Machinery of all kinds. Latest styles and designs at reduced prices. Send for descriptive catalogue and price list of the celebrated Lehigh Emery Wheels. Lehigh Valley Emery Wheel Co., Lehighton, Pa.

Blake's Belt Studs. The strongest and best fastening for leather and rubber belts. Greene, Tweed & Co., N. Y.

In stock, ready for immediate delivery, all new, 24 in. Rotary bed Single Surfacer; No. 3 Wardwell's patent Saw Bench; 20 in. Upright Drill Press, hand feed, quick return; Cady Engine Lathe, 13 in. by 4 ft. Send for list of 2,000 new and second-hand machines. Rollstone Mchn. Co., 95 Liberty St., New York.

To make Violins, write James Roblee, Syracuse, N. Y.

Water purified for all purposes, from household supplies to those of largest cities, by the improved filters manufactured by the Newark Filtering Co., 177 Commerce St., Newark, N. J.

American Fruit Drier. Free Pamphlet. See ad., p. 334

Am. Twist Drill Co., Meredith, N. H., make Pat. Chuck Jaws, Emery Wheels, Grinders, automatic Knife Grinders.

Fire Brick, Tile, and Clay Retorts, all shapes. Bornerg & O'Brien, M'f'rs, 23d St., above Race, Phila., Pa.

Peck's Patent Drop Press. See adv., page 334.

For best Portable Forges and Blacksmiths' Hand Blowers, address Buffalo Forge Co., Buffalo, N. Y.

Drop Forgings. Billings & Spencer Co. See adv., p. 333.

Brass & Copper in sheets, wire & blanks. See ad. p. 332.

The Chester Steel Castings Co., office 407 Library St., Philadelphia, Pa., can prove by 20,000 Crank Shafts and 15,000 Gear Wheels, now in use, the superiority of their Castings over all others. Circular and price list free.

The Improved Hydraulic Jacks, Punches, and Tube Expanders. R. Dudgeon, 24 Columbia St., New York.

Diamond Saws. J. Dickinson, 64 Nassau St., N. Y.

Eagle Anvils, 10 cents per pound. Fully warranted.

Tight and Slack Barrel Machinery a specialty. John Greenwood & Co., Rochester, N. Y. See illus. adv. p. 332.

Garmore's Artificial Ear Drums for relief of partial or entire deafness. Invented by one who has been deaf thirty years. Simple and scientific in construction; not observable in use. Send for circular. John Garmore, S. W. cor. 5th and Race Sts., Cincinnati, O.

Pure Turkey Emery, Glue Composition, Rouge, and Pumice for polishers. Greene, Tweed Co., New York.

Heliographic or Blue Process Paper to take copies of Drawings, at Keuffel & Esser, 127 Fulton St., New York.

Pays well on small investment.—Stereopticons, Magic Lanterns, and Views illustrating every subject for public exhibitions. Lanterns for colleges, Sunday-schools, and home amusement. 116 page illustrated catalogue free. McAllister, Manufacturing Optician, 49 Nassau St., N. Y.

Cutters for Teeth of Gear Wheels formed entirely by machinery. The Pratt & Whitney Co. Hartford, Conn.

Catechism of the Locomotive. 625 pages, 250 engravings. Most accurate, complete, and easily understood book on the Locomotive. Price $2.50. Send for catalogue of railroad books. The Railroad Gazette, 73 B'way, N.Y.

Trevor's Patent Key Seat Cutter. Trevor & Co., Lockport, N. Y. See page 332.

Assays and Analyses of ores and all commercial products. Advice given and investigations made in all branches of chemical industry. Send for circular. N. Y. Assay Laboratory, 40 Broadway, New York.

Wanted.—A second-hand centrifugal machine for liquids Address, with description and price, P. O. Box 3596, Boston, Mass.

Small patented articles, or light machinery, made and introduced. Gaynor & Fitzgerald, New Haven, Conn.

Lubricator. See advt., Detroit Lubricator Co., p 318,

Bostwick's Giant Riding Saw Machine, adv., page 318.

See New American File Co.'s Advertisement, p. 318.

Steam Pumps. See adv. Smith, Vaile & Co., p. 316.

Common Sense Dry Kiln. Adapted to drying of all material where kiln, etc., drying houses are used. See p. 318.

The Sweetland Chuck. See illus. adv., p. 318.

Knives for Woodworking Machinery, Bookbinders, and Paper Mills. Taylor, Stiles & Co., Riegelsville, N. J.

Red Jacket Adjustable Force Pump. See adv., p. 302.

Woodwork'g Mach'y. Rollstone Mach. Co. Adv., p. 302.

Cope & Maxwell M'f'g Co.'s Pump adv., page 285.

Sheet and cast brass goods, experimental tools, and fine machinery. Estimates given when models are furnished. H. C. Goodrich, 66 to 72 Ogden Place, Chicago.

Improved Skinner Portable Engines. Erie, Pa.

Engines, 10 to 50 horse power, complete, with governor. $250 to $550. Satisfaction guaranteed. Nearly seven hundred in use. For circular address Heald & Morris (Drawer 127), Baldwinsville, N. Y.

25" Lathes of the best design. G. A. Ohl & Co., East Newark, N. J.

Combination Roll and Rubber Co., 68 Warren street, N. Y. Wringer Rolls and Moulded Goods Specialties.

First Class Engine Lathes, 20 inch swing, 8 foot bed, now ready. F. C. & A. E. Rowland, New Haven, Conn.

Ice Making Machines and Machines for Cooling Breweries, etc. Pictet Artificial Ice Co. (Limited), 142 Greenwich Street. P. O. Box 3083, New York city.

Soapstone Packing, Empire Packing, Hemp Packing, Rubber Packing of all kinds. Greene, Tweed & Co., N. Y.

Jas. F. Hotchkiss, 84 John St., N. Y.: Send me your *free* book entitled "How to Keep Boilers Clean," containing useful information for steam users & engineers. (Forward above by postal or letter; mention this paper.)

Steel Stamps and Pattern Letters. The best made. J. F. W. Dorman, 21 German St., Baltimore. Catalogue free.

For Power & Economy, Alcott's Turbine, Mt. Holly, N. J.

Presses, Dies, Tools for working Sheet Metals, etc. Fruit and other Can Tools. E. W. Bliss, Brooklyn, N. Y.

Presses & Dies (fruit cans) Ayar Mach. Wks., Salem, N.J.

Split Pulleys at low prices, and of same strength and appearance as Whole Pulleys. Yocom & Son's Shafting Works, Drinker St., Philadelphia, Pa.

For Mill Mach'y & Mill Furnishing, see illus. adv. p. 300.

Supplement Catalogue.—Persons in pursuit of information on any special engineering, mechanical, or scientific subject, can have catalogue of contents of the SCIENTIFIC AMERICAN SUPPLEMENT sent to them free. The SUPPLEMENT contains lengthy articles embracing the whole range of engineering, mechanics, and physical science. Address Munn & Co., Publishers, New York.

Machinery for Light Manufacturing, on hand and built to order. E. E. Garvin & Co., 139 Center St., N. Y.

Presses & Dies. Ferracute Mach. Co., Bridgeton, N. J.

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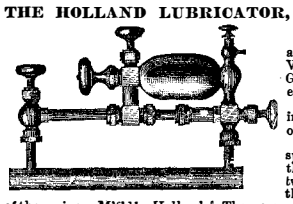

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SIMPLEST, LATEST IMPROVED
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IF THERE IS NO AGENT NEAR YOU WRITE DIRECT TO US.
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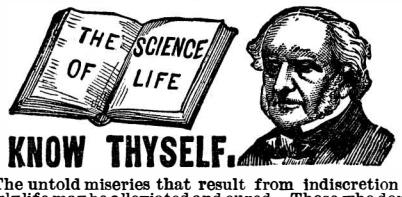

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The untold miseries that result from indiscretion in early life may be alleviated and cured. Those who doubt this assertion should purchase and read the new medical work published by the **Peabody Medical Institute,** Boston, entitled the **Science of Life; or, Self Preservation.** It is not only a complete and perfect treatise on Manhood, Exhausted Vitality, Nervous and Physical Debility, Premature Decline in man. Errors of Youth, etc., but it contains one hundred and twenty-five prescriptions for acute and chronic diseases, **each one of which is invaluable,** so proved by the author, whose experience for 21 years is such as probably never before fell to the lot of any physician. It contains 300 pages, bound in beautiful embossed covers, full gilt, embellished with the very finest steel engravings, guaranteed to be a finer work in every sense—mechanical, literary, or professional—than any other work retailed in this country for $2.50, or the money will be refunded in every instance. Price only $1.25. Gold medal awarded the author by the National Medical Association. Illustrated sample sent on receipt of six cents. Send now.
Address PEABODY MEDICAL INSTITUTE, or DR. W. H. PARKER, No. 4 Bulfinch Street, Boston, Mass. The author may be consulted on all diseases requiring skill and experience.

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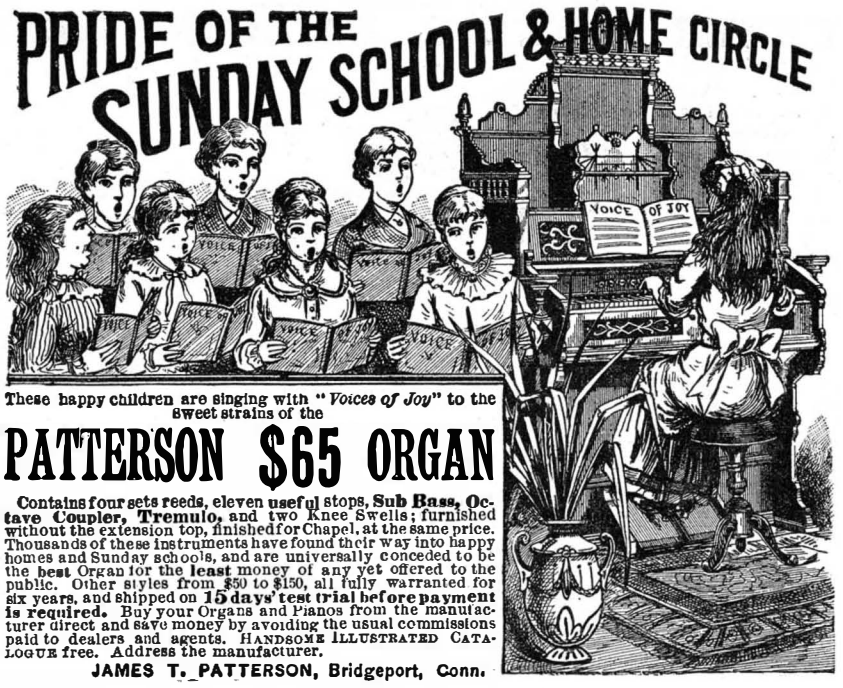

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Contains four sets reeds, eleven useful stops, **Sub Bass, Octave Coupler, Tremulo,** and two Knee Swells; furnished without the extension top, finished for Chapel, at the same price. Thousands of these instruments have found their way into happy homes and Sunday schools, and are universally conceded to be the **best** Organ for the **least** money of any yet offered to the public. Other styles from $50 to $150, all fully warranted for six years, and shipped on **15 days' test trial before payment is required.** Buy your Organs and Pianos from the manufacturer direct and save money by avoiding the usual commissions paid to dealers and agents. HANDSOME ILLUSTRATED CATALOGUE free. Address the manufacturer.
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CHLORIDE OF GOLD
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I have a positive remedy for the above disease; by its use thousands of cases of the worst kind and of long standing have been cured. Indeed, so strong is my faith in its efficacy, that I will send TWO BOTTLES FREE, together with a VALUABLE TREATISE on this disease, to any sufferer. Give Express & P. O. address, DR. T. A. SLOCUM, 181 Pearl St., N. Y.

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GREAT WESTERN GUN WORKS, Pittsburgh, Pa.
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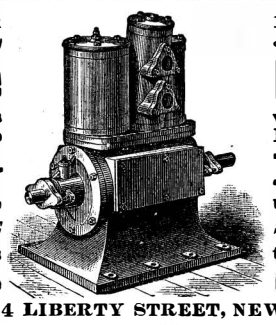

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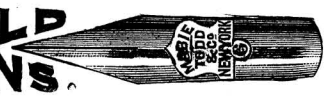

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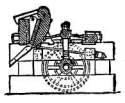

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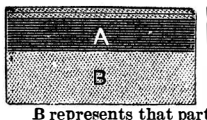

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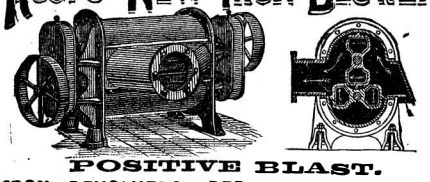

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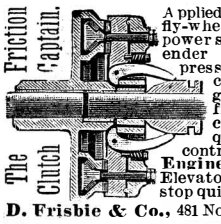

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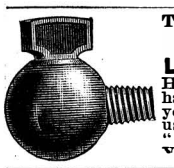

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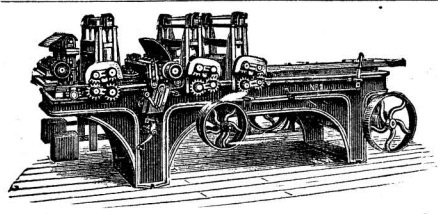

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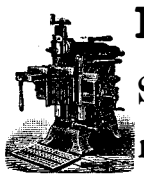

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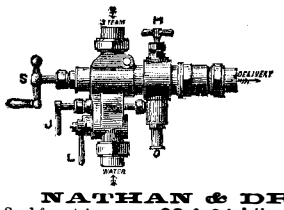

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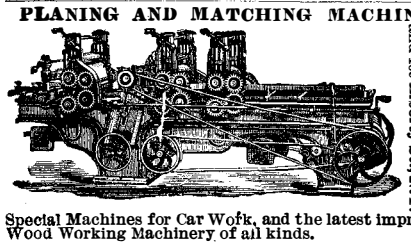

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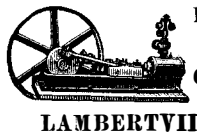

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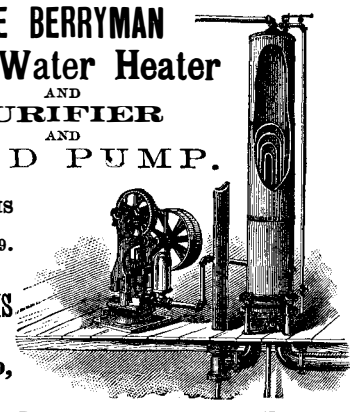

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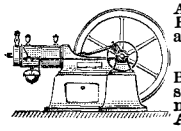

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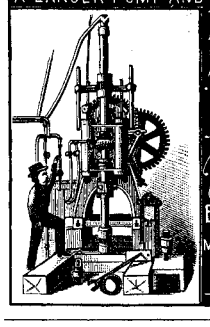

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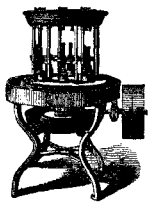

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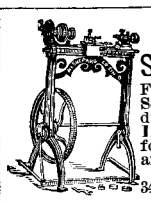

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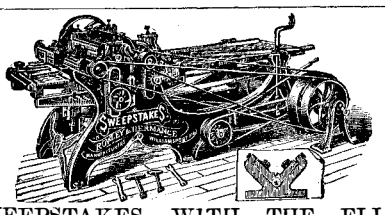

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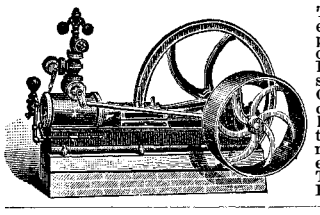

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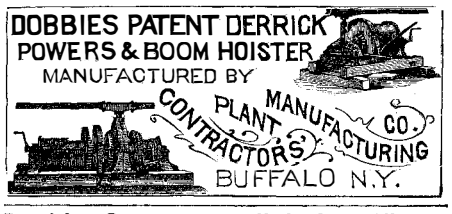

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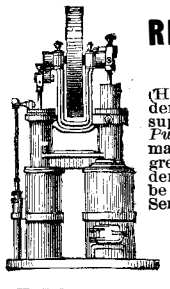

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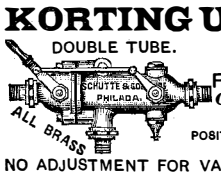

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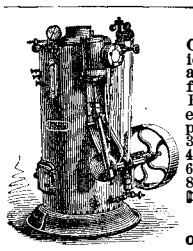

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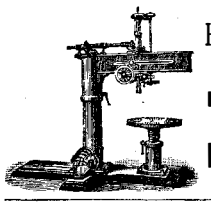

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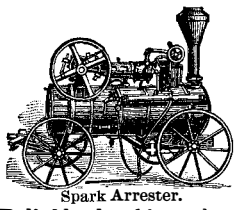

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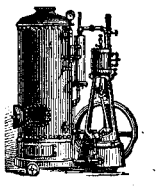

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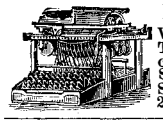

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